THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 41. Thursday, September 19, 1929. No. 683.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (4 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

SEPTEMBER 4-22.

German Foundry Exhibition at Düsseldorf, Germany.

SEPTEMBER 12-28.

Shipping, Engineering and Machinery Exhibition at Olympia, London.

Institute of British Foundrymen.

SEPTEMBER 27.

Sheffield and District Branch:—Presidential address and discussion, followed by a smoking concert.

Our Native Advantages.

It is rapidly becoming a matter of habit with foundrymen to study, with a view to possible profit, the conditions, the methods and the problems of the foundry trade abroad. We hear, in fact, a great deal about features of foreign development that we should do well to emulate, and there is no doubt that in many instances such emulation would be very much to our advantage—foundry education in France, applied research in Germany, specialisation in the U.S.A., etc. But with characteristic modesty we neglect to point out our own peculiar advantages, and we even fail to draw the obvious conclusions when foreign visitors do it for us.

For we in England have, after all, certain advantages of our own, and although they should not blind us to the lessons that are to be learnt from abroad, they are not to be neglected, since by making the most of them we can do as much as by emulating the merits of others. We have the best coal deposits in the world, and as a consequence we have the best cupola coke that could be desired. We have excellent moulding sands, and we have a good working climate. We have a dense population, and in consequence we have magnificent transport facilities, as well as the ports and other natural advantages of our situation. We are as a nation organised for industry, and we have a long and valuable tradition as producers of quality goods and craft products. Above all, we have the British artisan. He will not work as hard or as long as the Frenchman, that is true; he wants higher wages than the German; he likes to spend his evenings and week-ends in amusements of his own—football, the dirt-track, politics—instead of devoting them to the study of his trade like the Belgian. But for all that he is more intelligent, more adaptable, more skilful, and more satisfactory to work with than any of them. If he works less hard, he works more intelligently. If he works shorter hours, he wastes less time—and less material. If he demands higher wages, he earns them. If he fritters away his leisure time, he is as a result healthier, more cheerful, more energetic, and if he studies less he brings more native common sense to his job in the first place. He is probably the most self-respecting, the most intelligent, the most adaptable, and the most skilful artisan in the world, and he has behind him a national tradition of progress, of pioneering, and of good work that is certainly unequalled. Now and then, it is true, we are reminded that he also has the defects of his qualities—a certain independence, not to say obstinacy—but that is hardly surprising. By all means let us study foreign conditions and admit the lessons that they have to teach, but do not let us in the process forget our native advantages, and in particular the British artisan.

The Lesson of the German Foundry Exhibition.

It is certain that, at a minimum, some 25,000 people will visit this magnificent exhibition of foundry practice, problems and machinery. Now, from these figures it can be assumed that a very large number of people engaged in the industry is included, whilst still leaving a big residue of "men in the street." The strong appeal which has been made to this latter section is extremely important, as it reacts directly upon the foundry industry by replacing a vague impression of dirt and grime by a consciousness of its basic character and scientific outlook. It was not so much the ordinary industrial exhibits that impressed one, nor did the extent of the educational and technical exhibits create any serious mental reaction, but the real striking feature of the whole exhibition was the vivid method of getting the points home. For instance, a little coloured model showed proportionate heaps of all the materials essential for manufacturing a kilo of iron castings. Here, then, is shown the starting point for any transport system, and but little imagination is needed to visualise where economy can be effected. Striking, too, was the only too-typical foundry cupboard, with its balls of paper, tins of samples referring to some forgotten test, an empty tobacco tin, a paint pot with the usual firmly adhering brush, a dirty bag of some coal-dust sample, all covered with a liberal sprinkling of grime. At its side was a peg on which were hanging some discarded garments. Nearby, an old moulding machine, obviously too high, dirty, and encumbered with inconvenient mechanism. To see this in a modern and colourful exhibition cannot fail to impress either the rationalist or the *flâneur*. Only 50 people joined the official party organised by the B.C.I.R.A., and, unfortunately, they were of the type the least likely to benefit. They were enterprising individuals, whose works are modern and whose outlook is progressive. It is that large unorganised majority who would receive the maximum benefit. To those our advice is, get to Düsseldorf whilst there is yet time. If only the whole of the founders of Great Britain could examine in detail the exhibition, as has been our good fortune, there would be created and established a national organisation capable of doing big things—for in such a category falls the technical and educational exhibit in Düsseldorf. The industrial side was no better and no worse than London, but in this connection the existence of the Foundry Trades Equipment and Supplies Association puts us on level terms.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Testing the Quality of Grey-Iron Test-Pieces.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Speaking before Mr. Young in the discussion of the above Papers, it was not possible to question some of his remarks without infringing on the time at the disposal of other members. However, his revised version, which appears in your issue of September 5, offers an opportunity.

Whilst in agreement with his comments concerning the claims made by an optimistic official for the B.E.S.A. 321, I am at a loss to see, as it does not appear in the specification itself, what object Mr. Young has in introducing it into the discussion, except as a peg on which to hang the homily on the shortcomings of the fellow-members on the Committee. Surely the right thing to have done was to point this out to the B.E.S.A. itself. As a contribution to a solution of the testing problem or as constructive criticism, his remarks can be summed up as "The fine edge of nothing whittled down to a point."

They, however, make it necessary to restate that the original object of the I.B.F. Committee was not to put forward a new form of test but to remove certain anomalies that existed at the time in the test methods then in use (1) where castings made from same materials and under same conditions were actually rejected, or passed as excellent, dependent on the size of the test-bar used. If 1¾ in. dia. turned down to 1.128 in. dia. in the centre, the metal yielded 11 tons. A bar ½ in. dia. turned to ⅞ in. dia. in the centre from the same ladle gave 17 tons. Twelve tons was demanded; (2) *the unfair use of this small bar, giving high test results, to impress the inspector*, yet the metal might not be suitable for the much thicker casting; and (3) the use of one size of test-bar for all thicknesses of casting, often causing a preference for a metal that would give the test or at best a compromise between what is best metal for the casting or test-bar. Specification 321 has to a great extent eliminated the above, and there is no doubt, notwithstanding its known limitations, it will give, when used with discretion, more useful information to the foundryman and engineer than any other general specification in use. Certainly the two methods mentioned by Mr. Young would not add to its usefulness. For the "High Priest of Perlit" to cut test-bars from the down-runners of a casting, through which probably several tons of hot metal had been poured, is not in line with his teaching. To suggest that test-bars cut from heads or risers (those sumps of dross and dirt, with probably their very structure altered by the addition of feed metal of a different composition) and expect these to represent the casting itself is, in the words of a current phrase, "Grotesque and ridiculous." Mr. Young poses as representing unbiased opinion. Well, we have heard of another humorist, who stated "his opinion must be unbiased because he knew little or nothing of the particular subject." In this category, I am afraid, Mr. Young must be placed, because of his own confession he has never carried out a shear test on cast iron by the Frémont method. On the other hand, the active members have spent both time and money, making several hundred tests on various types of material, in a serious endeavour to arrive at the truth—surely a much greater compliment to the French proposals than mere lip service. Their conclusions are based on these results, which but confirm some of those mentioned by Siegle in 1923. Although published early in April last, their correctness has not been questioned, even in the French Paper, by Girardet, published since the Convention. The truth concerning the "Frémont" test has been so overshadowed by the principle of taking small test-pieces from the casting itself, that the unreliability of the shear-test results, when operating on metal of different compositions, has been lost sight of.

(1) It is quite true that under the closely-controlled conditions which operate in Audo's foundry an empirical figure* (after previous comparison with tensile and transverse tests) can be fixed that will denote suitable metal for certain castings. Any deviation from this will call attention that some irregularity from the standard condition has occurred. But it is equally true that with other compositions and conditions this empirical figure does not hold good,† and that it could pass as "Extra strong iron" material that would fail to give 28 cwts. on the 2-in. by 1-in. by 36-in. bar. Le Thomas points out also‡ that the shear-test result goes up with every increase of free cementite.

(2) It may also be granted that under the same closely-controlled conditions that an empirical ratio can be fixed with fairly near results, between shear and tensile, but, again, with different composition that ratio seriously alters. So the shear result cannot be used with safety to determine the tensile load for design or even to calculate to see if a beam is strong enough.

(3) It is also true that if one takes a bar of cast iron and turns it down to shear-machine test-size, parallel to its axis, shear tests along that bar will be fairly concordant. If, on the other hand, one trepans a test-piece right through the casting, the shear test near the skin may register fully 3 tons more than one nearer the centre.

All the above are shop tests, and no one, least of all the writer, would have any objection to them being used as such or if the Frémont test became the national one in France. The objection is raised because there is a persistent endeavour to force this test forward as the chief physical test for cast iron in an International Specification and the refusal to consider any other method or to rebut the objections raised.

Up to now this question has been examined principally from the foundry or production side. How will this new test affect the inspecting engineer? He has to inspect and test anything from manhole covers to Diesel liners. So far his chief physical tests have been tensile and transverse. Can he with equal confidence trepan several small pieces from a casting and, if on the Frémont test he obtains 25 kg. m/m², pass that casting as being "Extra strong," or if 20 kg. m/m², strong iron. Or must the engineer include in his specification for manholes the composition of the metal, the melting procedure and the type of raw material before he can fix the shear-empirical figure needed to give the strength-iron he requires. British experiments prove, I think, that a fixed shear figure is unreliable with different compositions. Even Mr. Young states that "The one and sole way of showing the properties of the casting is when the composition of the metal and the components of the cupola charges are known factors." Does Mr. Young suggest these items be included in a general international specification? If so, who is to be responsible if the test fails, and must the inspector take charge of your foundry to see them carried out? I repeat we are discussing the most suitable test to be included in an international specification, not shop routine tests. If I could persuade Mr. Young to vacate his "Pedestal in mid-channel" would he consider the following. For the moment let all concerned delete from the question what may be considered the minor objections to the shear test, such as type of machine, size of test-piece, correct size of test-piece, where test-piece shall be taken from, etc., and get down to "bed-rock."

If Mr. Young received instructions from the Crown Agents to examine a series of castings consisting of bars 2 in. by 1 in. by 42 in., together with their usual specification, but in which a Frémont test asking for 25 kg. m/m² was substituted for the usual tensile and transverse, and on examination found these castings fulfilled the specification, yet when tested transversely at 36-in. centres failed to give 28 cwts., would Mr. Young report these castings as being "Extra strong" in accordance with Le Thomas specification, or would he reject them because they failed to reach the lowest British test? These results are not freak ones or unsual compositions, as a glance at the first nine in Table A, FOUNDRY TRADE JOURNAL, August 29, page 148, will show, and if Mr. Young requires further confirmation let him examine every bar he meets with about these compositions that fail to give 29 cwts., and then make a Frémont test on them.—Yours, etc.,

J. SHAW.

Parkstone Avenue,
Southsea,

* See Audo, I.B.F., 1927, p. 140.
† F.T.J., August 29, p. 148, Tables A and C.
‡ A.F.A., 1929, p. 729.

Cupola Linings.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—It was with great interest I read Dr. Zirker's article on Rammed Cupola Linings in the current issue of your journal inasmuch as its author was for some length of time demonstrator for our Berlin house and the information he gives is based on his experience with our Monolithic lining material at many works in Germany at a number of which I accompanied him.

I think it speaks well for the quality of British material that a man of Dr. Zirker's reputation should not only demonstrate the material but should afterwards give a lecture on his experiences with it before German foundrymen.—Yours etc., THOMAS E. GRAY & COMPANY, LIMITED,
THOS. H. GRAY, Managing Director.

119, High Holborn,
London, W.C.1.

Elimination of Sulphur from Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With reference to the article on "The Elimination of Sulphur from the Alloys of Iron" by Mr. K. Gierdziejewski, appearing in your issue of August 29, we are able to confirm Mr. E. J. L. Howard's statement that there is on the market a ladle-lining material suitable for the treatment of molten iron with soda ash.

To attempt desulphurisation with soda ash in a ganister-lined ladle amounts to the preparation of impure sodium silicate by a costly method, this being substantiated by Mr. Howard's figures of 30 to 35 per cent. reduction of the sulphur content. Under similar conditions with a lining of Neutraline, which is not attacked by soda ash or cupola slag, a desulphurisation of 45 to 50 per cent. would be obtained.—Yours, etc.,

F. W. BERK & COMPANY, LIMITED,
J. R. BOOER, B.Sc., F.C.S.

106, Fenchurch Street, London, E.C.3.

Steel Foundry to Close.

Notices terminating on September 17 were served on 200 men employed at the steel foundry of Messrs. Vickers-Armstrongs at Elswick, Newcastle.

An official of the firm stated that the recent decision of the Government involving the cancellation and suspension of contracts for naval armaments had had a very serious effect on the works, and as a result of this decision the firm was reluctantly compelled to close its steel foundry for an indefinite period.

The Coalescence of Pearlite.*

By J. H. Whiteley (Consett).

(*Abridged.*)

During the course of the investigation here recorded a variety of samples was used, three of which were:—(A) Normalised solid bath sample from an acid furnace; (B) acid-steel plate, 1 in. thick, which had been heated to about 1,250 deg. C., very slowly cooled and then normalised. This treatment was given in order to obtain a uniform sample free from the banded structure common to rolled steel; (C) basic-steel plate, 1 in. thick, containing 1.10 per cent. of manganese.

The analyses of these samples are given in Table I.

TABLE I.—*Analyses of Samples.*

Sample.	Combined carbon.	Silicon.	Phosphorus.	Sulphur.	Manganese.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
A	0.24	0.04	0.04	0.049	0.04
B	0.20	0.02	0.06	0.065	0.52
C	0.31	0.09	0.02	0.041	1.10

The transformation of γ-iron solid solution to pearlite in hypo-eutectoid steels occurs over a short range of temperature and not at a single point. This can readily be demonstrated by slowly cooling a number of specimens of the same steel from 900 deg. C. and quenching one at intervals as the temperature falls between 700 deg. C. and 660 deg. C. At about 695 deg. C., with specimens similar to sample B, a few areas of pearlite are generally to be seen scattered among the γ-iron areas; after 2 hrs. at this temperature the number increases, but many γ-iron areas are still present. On quenching a specimen cooled to 685 deg. C., more pearlite areas are found, yet even after 1 hr. or more at that temperature some γ-iron may remain. At 670 deg. C., transformation of the whole of the γ-iron is obtained in a comparatively short time. Experiments of this kind show that the transition occurs progressively and at an increasing rate as the temperature falls.

When examining a series of specimens treated in the above manner, it was noticed that pearlite areas which had grown during a long period of heating at the higher temperatures were often heavily bordered with cementite. Although this effect appeared to be in accordance with the well-known fact that the coarseness of pearlite increases to a certain extent as the rate of cooling is retarded, the cause was not clear. In order, if possible, to discover this, further experiments were made, as described below.

Specimens of sample B were heated for 15 min. at 900 deg. C. and then furnace-cooled to 695 deg. C., 690 deg. C., and 685 deg. C. respectively. Several were held at each temperature for periods ranging from ½ to 3 hrs. before they were quenched. Temperature readings were taken at frequent intervals by means of a Cambridge potentiometer; variations recorded seldom exceeded ± 2 deg. C. from the mean. The slow rate of the transformation at these temperatures was again clearly demonstrated. After 3 hrs. at 695 deg. C., the majority of the areas were still γ-iron, and at 685 deg. C. not more than three-quarters had changed to pearlite in 2 hrs. In these tests also, a very pronounced marginal coalescence was present in many of the pearlite areas. Further, it was observed that where this coalescence had occurred a widening and thickening of the laminæ throughout the grains frequently appeared to have been in progress. In some specimens, particularly those heated at 690 deg. C. and 695 deg. C., the laminæ had, in fact, completely merged into large irregular masses of cementite.

The examination of specimens quenched from 685 deg. C. showed very clearly that, at a fixed temperature also, the change from γ-iron solid solution to pearlite was progressive, for the number of pearlite areas steadily increased with the time of heating. In the specimens withdrawn early little marginal coalescence could be seen; these cementite borders became prominent in the later samples, thus indicating that they were formed subsequently to the initial growth of the pearlite. This was also evident from the fact that occasionally lamellar pearlite in process of growth at the time of quenching was found, and in these new areas no appreciable thickening of the marginal cementite could be detected. The varying degree of coalescence to be observed in any one specimen after a lengthy heating can thus be explained. Those pearlite areas which show most have been among the first to appear.

Some time ago, Hanson suggested an entirely different explanation of the way in which marginal coalescence occurs. He stated that ferrite continued to separate below the true eutectoid point down to a certain temperature, and "because the solution was thus supersaturated there was a rapid deposition of cementite before the pearlite began to come out." This explanation fails to account for the effects obtained during slow growth in the above experiments, for, as already indicated, the extent of coalescence increased both with the length of heating and with the temperature. Obviously, if it had been solely due to the initial precipitation of carbide in excess of the eutectoid proportion in the γ-iron areas, the reverse should have been the case with regard to temperature, since supersaturation increases as the temperature is lowered.

Again, when specimens of sample B were air-cooled instead of quenched after they had been held at about 690 deg. C. for an hour or more, the pearlite which formed as the pieces cooled could readily be distinguished from that formed at the stationary temperature. The earlier pearlite was generally much coarser and, as usual, showed strong marginal coalescence. If this had been merely due to the initial separation of excess of carbide in the supersaturated γ-iron areas, such an excess should also have been visible in the dark pearlite which was the last to grow. Under high magnification this pearlite appeared quite normal; it was finely lamellar, and little or no coalescence was to be seen at the margins. It is, in fact, extremely doubtful whether excess of carbide ever separates first. During the present investigation many hundreds of γ-iron areas quenched from within the transformation range have been examined, and in no instance has one been observed with a border of cementite—not even when crystallisation of pearlite was in progress at the time of quenching.

Another explanation of marginal coalescence was given by Stead. He stated that "the series of knob-like extremities were not there when they came out of solution, and only became bulbous by coalescence and segregation at some temperature below the critical point. Had the favourable conditions for this movement been allowed to continue for a much longer time, the terminations would have segregated to such a thickness that they would have joined together to form a solid enveloping ring of massive cementite and possibly have segregated into a large mass." To obtain this result, however, the presence of some γ-iron areas in close proximity to the pearlite appears to be essential. For instance, a section of sample B was heated to 695 deg. C., held there for 3 hrs. and quenched; no γ-iron had formed at this temperature, and no increase in the marginal coalescence of the pearlite areas could be detected. In the original piece very thin continuous cementite borders were frequently present. These, in the heated piece, had for the most part broken up into minute globules, and almost complete spheroidisation of the cementite laminæ had also occurred.

In another experiment, a section of sample B was heated for 30 min. at 800 deg. C., and as the furnace cooled down a second piece was inserted at 750 deg. C. for 3 min., previous experiments having shown that this short heating was not sufficient to dissolve completely all the cementite. The temperature was next lowered quickly to 695 deg. C., and the pieces were held there for 1 hr. before they were quenched. In the first specimen a few pearlite areas had formed with the usual marked coalescence. In the second, no γ-iron areas were present; the undissolved cementite particles in them had acted as nuclei, and had caused the rapid formation of globular pearlite, as previously described by the author. These experiments thus clearly indicate that, in the absence of γ-iron, marginal coalescence does not occur. The tendency is rather for carbide films to break up into globules.

It is evident, therefore, that cementite borders to pearlite are due to a continued growth after formation, and that the carbide necessary for this growth is supplied by the adjacent γ-iron areas. This transference of carbide from γ-iron to pearlite must take place by diffusion through the intervening ferrite, which at 700 deg. C. can hold about 0.03 per cent. of carbon in solid solution. The rate of diffusion is extremely rapid, and the speed at which coalescence progresses may thus be accounted for. Evidence was also given which indicated that the solubility of carbon was diminished by the presence of manganese in the ferrite; since it is a matter of common observation that coalescence tends to increase as the manganese content of steel is reduced, the effect of holding samples both high and low in manganese in the pearlite range appeared well worth examining.

Sample C was selected to illustrate the result obtained with steels comparatively high in manganese. In a specimen cooled in the furnace from 900 deg. C. to 675 deg. C. and held there for 2 hrs. before showed the presence of many γ-iron solid solution areas but no appreciable thickening of the pearlite borders had occurred. The retardation of coalescence with an increasing manganese content was very marked in all the tests made.

In steels containing less than 0.1 per cent. of manganese the rapidity of coalescence was remarkable. It was found sufficient to hold samples for 1 hr. only in the transformation range in order to change completely the majority of the pearlite areas which had formed into irregularly shaped masses of cementite. For instance, a section of sample A was heated for 15 min. at 900 deg. C., cooled in the furnace to 710 deg. C., held there for two hours and quenched. The resulting structure showed here and there large masses of cementite surrounded by zones of ferrite from which γ-iron was completely absent. The γ-iron originally present in these zones had evidently supplied the carbide necessary for the further growth and ultimate coalescence of a pearlite area which had formed near the centre of each. This process had continued until all the γ-iron areas in the vicinity of the central pearlite area had disappeared.

The effect obtained by holding another specimen of sample C for 2 hrs. at 705 deg. C. can be accounted for in the same way. At the slightly lower temperature many more γ-iron areas were transformed. The opportunity for coalescence through growth was, therefore, less than in the previous case for any particular pearlite area, since the amount of carbide available for the purpose was also less. Consequently,

* A Paper read before the Autumn meeting of the Iron and Steel Institute.

a smaller average size of cementite crystal was produced.

These observations thus plainly indicate that coalescence at pearlite margins is the result of a gradual growth and thickening of the carbide laminæ after their initial formation. It is obvious that such growth could not take place unless the surrounding ferrite were supersaturated with carbide.

When ferrite begins to separate below Ar_3, the steel no longer consists of a single solid solution; two phases are then present, one of carbon in γ-iron, the other of carbon in α-iron. The distribution of carbon between the two will therefore tend towards a definite ratio, the partition coefficient. Equilibrium at any temperature in the critical range will quickly be established, especially when the grain-size is small, since carbon diffuses rapidly in both constituents. As the temperature falls, the carbon content of the γ-iron steadily increases and, assuming the partition coefficient to remain constant, that of the ferrite must also increase. Now, since the solubility of carbon in ferrite is low, a point may eventually be reached where the distribution can no longer comply with the partition law. It seems probable that this point is not far removed from Ar_1.

With a further fall in temperature, the ferrite will thus tend to become supersaturated, and a minute amount of carbide may consequently be precipitated from it. The initial growth of pearlite may, in fact, be due to inoculation of certain of the γ-iron areas by the carbide nuclei so formed. When once pearlite is present and the temperature is kept constant, the continued growth at the margins of the carbide laminæ by deposition from the supersaturated ferrite will largely prevent the appearance of further nuclei. This steady transference of carbide bears some resemblance to an effect known to occur when, for example, water and ice are kept separately in the same enclosed space at a temperature below freezing point. Here, the air in the space becomes supersaturated with water vapour with respect to the ice, owing to the fact that, below 0 deg. C., water has a slightly higher vapour pressure than ice, and a gradual transference of the supercooled water to the ice takes place. Similarly, in the γ-iron-ferrite-pearlite system, the ferrite becomes supersaturated with carbide with respect to the cementite when the A_e point is passed, with the result that the eutectoid cementite present grows at the expense of the γ-iron until the margins of the laminæ eventually meet and coalesce.

Summary.

The transformation of γ-iron solid solution to pearlite in hypo-eutectoid steels occurs over a small range of temperature immediately below the A_e point. It is shown that coalescence resulting in the formation of cementite borders to pearlite takes place within this temperature range, and before all the γ-iron is transformed; it is due to the fact that carbide is transferred by diffusion from the γ-iron to the adjacent pearlite areas. It follows that the longer the time during which the steel is cooling through the Ar_1 range, the greater will the coalescence tend to be.

The most marked effects were produced in steels very low in manganese. With samples containing more than 1.0 per cent. coalescence was not obtained.

Marking of Imported Refractory Bricks.

The Standing Committee (General Merchandise) appointed by the Board of Trade will hold an inquiry on Monday and Tuesday, October 7 and 8, at 11.30 a.m. and 10.30 a.m. respectively, as to whether imported refractory bricks, blocks and tiles should bear an indication of origin.

Institute of Metals.

AUTUMN MEETING AT DÜSSELDORF.

The Annual Autumn Meeting of the Institute of Metals was held in Düsseldorf, Germany, from September 9 to 12, the hosts being the Verein Deutscher Ingenieure and the Deutsche Gesellschaft für Metallkunde. An excellent programme was arranged, and the local Reception Committee, and in particular Dr. Max Haas, the honorary local secretary, are to be congratulated on the successful meeting which was largely the result of their efforts.

Nearly 300 members and their ladies registered at Düsseldorf, 15 countries being represented. The main party travelled overnight from London, arriving in Düsseldorf on Monday morning, September 9. In the afternoon there was a visit to the German Foundry Trades Exhibition. This will be dealt with elsewhere, but it might be mentioned that one of the outstanding features of the exhibition was the large amount of space devoted to exhibits of an educational and technical character. Following this visit, the Autumn Lecture on "Aluminium and Its Alloys" was delivered, in German, by Dr. A. G. C. Gwyer.

Professor Tammann made Honorary Member.

The technical sessions were held in the beautiful lecture hall of the Eisenhüttenhaus Verein Deutscher Eisenhüttenlente, and at the first one, on the morning of September 10, the Institute was welcomed to Germany, and Düsseldorf in particular, by Mr. R. Keith Jopson, Acting British Consul-General at Cologne, and Prof. Bauer. It was particularly fitting that this occasion should have been chosen for conferring the honorary membership of the Institute on Prof. Tammann, Director of the Institute of Physical Chemistry, Göttingen. The President (Dr. W. Rosenhain), having made the announcement, called on Prof. Tammann, who received a great ovation when he rose to reply.

The meeting then settled down to the discussion of some of the fourteen communications which had been submitted. The first two Papers were "Some Methods of Research in Physical Metallurgy," by Dr. W. Rosenhain (President), and "Methods of Research in Metallography," by Dr. G. Masing. These gave rise to a lengthy discussion, and were followed by two Papers on dilatometry, namely, "A Dilatometric Study of Some Uni-Variant Two-Phase Reactions," by Chevenard, Portevin and Waché, and "An Improved Differential Dilatometer," by Max Haas and D. Uno.

At the second technical session, held on Wednesday morning, a Paper by M. Tama on "Progress in Electric Furnaces for Non-Ferrous Metals" evoked a lengthy and important discussion, in which many of the authorities on the subject took part.

Works Visits.

The afternoons of Tuesday and Wednesday were devoted to works visits, and parties visited the following works:—J. G. Schweitzke (non-ferrous foundry), A. Schmitz (rolling-mill works), August Thyssen-Hütte (steelworks), Demag A.G. (makers of mining and metallurgical machinery), Berg-Heckmann-Selve A.G., Zweigniederlassung C. Heckmann (copper works) and the Kaiser William Institute for Iron Research. All of these were definitely interesting, and the thanks of the Institute are due to the various firms not only for allowing members to visit their works, but also for selecting guides who, in the majority of cases, could speak English.

Visit to Krupp, of Essen.

The whole of Thursday was given over to a visit to Messrs. Krupp, of Essen. Members left Düsseldorf by special trains, arriving at Essen at 9.30 a.m. They then proceeded direct by

(*Continued on page* 218.)

Random Shots.

September is still with us, but it has already, so to speak, paid its way in the matter of activity. We have had the Iron and Steel Institute Meeting in Newcastle—the outstanding feature of which seems to have been the vast profit that accrued to the local tradesmen on account of the traditional absent-mindedness of our foundry experts. One greatly respected member turned up without his dress boots, another without his trousers, and I have heard hints of even darker disasters, if you can conceive of any worse disaster than turning up at such a meeting without—your boots! It is to be hoped that when the Iron and Steel Institute goes to Czechoslovakia next year it goes a little better prepared—I should just hate to think what might happen if the Czech shopkeepers were suddenly called upon to rise to such an occasion!

* * *

At the same time the Institute of Metals overflowed in Düsseldorf—some 260 odd of them. The Institute of Metals is never behind where social activities are concerned, and this year's meeting was no exception to the rule—especially from the point of view of the ladies, one presumes, since they were in the ratio of one to four—and there was dancing! The meeting was especially noteworthy for its genuinely international character. Not only were fifteen different nations represented, but there was a real and wholehearted intermingling of hosts and guests. It must be confessed that our English disdain of foreign languages shows up very much to our disadvantage on an occasion like this. Every German member could produce a few words of English, whereas all too many of the English visitors seemed to think that it was only necessary to ask for a thing long enough and loud enough in English in order to get it. There were happy exceptions, the one most appreciated being that of the President, who spoke on several occasions in German of considerable felicity—or so I was given to understand by those who heard him.

* * *

Hard on the heels of the Institute of Metals came a party of about fifty foundrymen under the ægis of the Cast Iron Research Association, to see the Foundry Exhibition and a number of works in the Düsseldorf locality. They saw a variety of moulding machines; they saw one of the new furnaces, that will, it is claimed in some quarters, oust the cupola, they saw some celebrated light castings foundries, and they saw the Exhibition.

* * *

But those who saw it will agree that it is not possible to write of it with justice in a few lines at the end of a column, and I must, perforce, postpone it till next week. Nor could I in the same space deal any more adequately with the non-technical aspects of the Düsseldorf visit, although I could give you the names of several gentlemen who would be only too glad to act as consultants to anyone who wants a good time there. . . . It is said that Englishmen take their pleasures sadly, but assuredly they take their sorrows gladly, always assuming that four works visits in forty-eight hours of broiling heat do constitute a sorrow!

* * *

I strongly deprecate the habit these founders have of forming clubs as a souvenir of each conference. Just because a small group found themselves continually ordering "funf" beers or "funf" tickets or still another "funf," they must necessarily form a "funf" club with rules that apparently resemble those of the Froth-blowers. The "fairy belles" attached to the Funf club bore the charming names of "Chocolate," "Buttercup," "Peach" and "Finesse."

Marksman.

British Cast Iron Research Association Members in Düsseldorf.

FOUNDRY EXHIBITION AND RUHR WORKS VISITED.

There has never been organised a more "worthwhile" (to use an Americanism) foundrymen's excursion than the one to Düsseldorf which has just concluded. Mr. Pearce and his colleagues on the staff of the British Cast Iron Research Association are deserving of the congratulations showered upon them at the final occasion upon which the members met. The party arrived in Düsseldorf last Thursday morning after a splendid journey, and were received in the lounge of the Hotel Monopol Metropole by Dr. Ing. Geilenkirchen, who is the Editor of "Die Giesserei," the manager of the Employers' Federation and of the Foundry Exhibition.

Dr. Geilenkirchen, speaking in the name of the V.D.E. (German Foundry Owners' Federation), heartily welcomed the members to the City of Düsseldorf and to the Foundry Exhibition, which latter he assured his listeners was bigger, better and more valuable than that held in 1925, on which occasion he had had the pleasure of receiving a similar party. He referred to the very pleasant memories that he and his German colleagues retained of the London Congress and Exhibition, and hoped that they would be able in some small measure to reciprocate. He hoped that the works visits which had been arranged would be profitable and pleasurable. Finally he announced that the Lord Mayor of Düsseldorf would accord the visitors an informal Civic Reception on the following Sunday at 11 o'clock in the Exhibition forecourt. He felt sure that the visit would cement the very cordial friendship which already existed between German and British foundrymen. Mr. J. G. Pearce, the director of the Cast Iron Research Association, expressed the thanks of the members for the reception accorded the members and for the programme which had been arranged in collaboration with the Doctor and his staff. He took the opportunity of announcing the final arrangements which had been made for the transport of the visitors.

Luncheon was then taken, and the visitors divided into two sections, the larger party visiting the works of Messrs. Gustav Zimmermann, the well-known makers of moulding machines, whilst a smaller party inspected the workshops of Losenhausenwerk, makers of testing machines. The ladies of the party were conducted round the city by Fraulein Engelbracht, of V.D.E., to whom special thanks are due for her unfailing kindness.

The Zimmermann party left in two motor coaches, and were received at the entrance to the works by Herr Zimmermann and Mr. Grindel, who was well known to many of the visitors as he took part in the 1926 trip to Detroit. After the group had been photographed, the party inspected first the demonstration foundry, wherein is installed a number of representative moulding machines of the latest type. Probably the most interesting one was a shockless jar ram machine, with adjustments to take care of the bonding properties of the sands used in such widely varying jobs as are found in iron and steel foundries. Each machine was surmounted by pneumatic rammers for finishing the tops. A small sand blowing core machine, of the type shown at the Agricultural Hall, was demonstrated, it being pointed out that a smaller quantity of oil gives better results than when using the ordinary mixtures.

After seeing the actual foundry and the machine shops, the visitors were entertained to light refreshments by Mr. Zimmermann, at the Rhein Terrace Restaurant.

Those who visited the Losenhausenwerk factory were received by Herr Direktor von Bohuszenco, who also went to much personal trouble to ensure that his guests received adequate explanations of the various machines built, whilst he too was lavish in the hospitality extended.

The evening was spent at the various cabarets, some of the younger members forming the "Funf Club," which promises to rival that other International foundry organisation, the Lancastrian Society. Apparently it has for its objects the co-ordination of the foundry and terpsichorean arts.

On Friday the members were the guests of Messrs. Berg & Company, of Koln, who kindly provided motor coaches to visit the foundry of Messrs. Senff & Sohn, of Süchteln. Here the party was joined by Capt. Gossell, the London representative of Messrs. Berg, who are responsible for many powdered fuel installations in both Germany and Britain. His presence, owing to his command of the German language, was much appreciated. The object of the visit was to inspect the much discussed Brackelsberg furnace. It was demonstrated to be a perfectly practical and workable unit for the production of high grade cast iron, and it undoubtedly constitutes a foundry development worthy of consideration by the larger establishments in the industry.

Luncheon was offered by the hosts at the local hotel, and the visitors thanks were expressed by Mr. Pearce and acknowledged by Herr Vogt, Capt. Gossell kindly acting as interpreter.

The journey was continued by motor coach to Krefeld, where the party entrained for Gelsenkirchen. At the station the party were met by Herr Langenohl, the manager of the Vereinigte Stahlwerke (United Steel Works) and Dr. Geilenkirchen. At the entrance to the works a short speech of welcome was made, explaining the growth and importance of the shops to be visited, facts which could be well appreciated after a tour of this gigantic and well organised establishment. First the generating station was visited, where blast-furnace gas is exploded in a set of 10 gas engines of the largest capacity. This was followed by a tour of the blast-furnace plant, the outstanding feature of which is the coke conveyor connecting the coke-oven plant about a quarter of a mile away with the charging platform. Some of the pig-iron is cast into the sand beds, and some is taken to 300 ton capacity mixers for refining and transferring whilst still liquid to the various foundries. This is the only plant on the Continent carrying out this particular practice.

The Delavaud pipe spinning plant, which is managed by Dr. Pardun, differs from the Stanton in several operating details. Primarily when the hot pipes leave the dies they are taken over head by a lever arrangement to a rail track, where they enter, by gravity, the soaking furnace, which uses blast-furnace gas for auxiliary firing. On the exit side of the furnace they are dipped into a preservative solution of a tarry nature, whilst remaining horizontal. The mechanical action for extracting the pipes, allowing to drain, sorting them, and passing them along to the pressure testing machines, is particularly well studied. The present output is in the nature of 1,000 tons a week. The average length of the pipes is apparently longer than in British practice.

A sand cast pipe foundry utilising mechanical ramming was next inspected, followed by a tour round the radiator foundry. Here some sixty types of radiators are made, and extensive use of blast-furnace gas is made for core drying. The moulds are made on roller-moulding machines. In the heavy foundry, which uses a considerable quantity of liquid mixer metal, facilities are available for making the largest types of castings. The last foundry shown was what the Germans term Fluss Arbeit or mechanised. Here was installed a thoroughly modern system of pendulum conveyors, for handling the cores and moulds and scraper conveyors for the sand.

Before leaving the guests were entertained at the works Casino to light refreshments, and opportunity was taken to felicitate the directorate on their achievements in blast-furnace and foundry practice.

In the evening the majority of the visitors visited the Jury Müller, where the management combine an excellent vaudeville show with dancing facilities.

On Saturday morning the visitors left by motor coach to the Gasmoforenfabrik Dentz at Cologne. The writer unfortunately was unable to participate, but was told by several of the visitors that the foundry was one of the most intelligently designed and operated foundries coming within their experience. They referred to a type of mould stoves with a removable roof, allowing of the castings to be loaded in directly by means of an overhead travelling crane. This system has been used for many years for the annealing of tool-steel bars. Herr Oberingenieur Küster received the visitors on behalf of his firm.

At 11 o'clock on Sunday morning, in the courtyard of the Exhibition, the members were accorded a civic reception by Herr Schiller, acting on behalf of the Lord Mayor of Düsseldorf (Der Oberburger-Meister, Dr.h.c.Lehr), who mentioned that earlier in the week the City authorities had had the honour of receiving the Institute of Metals. He referred to the reception accorded to the German delegation to the recent international congress held in London, and was happy in the thought that his City was now in a position to return in some small measure the hospitality then accorded. Finally he invited the members to join him in a glass of Rhein wine.

Dr. S. G. Werner, the chairman of the German Ironfounders' Employers Federation, welcomed the members on behalf of this association, saying that whilst his organisation was happy to have the opportunity of entertaining some 50 representatives of the British foundry industry, he hoped, that when in 1932 they staged the 4th International Foundry Congress, the number of British visitors would be more than double that number.

Mr. Pearce, speaking in German, thanked the various authorities and works for the hospitality they had shown, especially would he stress the untiring help accorded him in the organisation of the visit.

The visitors then drank the health of their hosts with musical honours, the wine offered being the famous 1921 vintage from the municipal cellars.

Advantage was taken of this last occasion at which all could be present to thank Mr. Pearce for efforts on their behalf, this duty being capably carried out by Mr. J. J. Cook.

The exhibition, to be described next week, was then visited. At lunch time a number of the members left for Karlsruhe and Mannheim, where visits were paid to the works of the Badische Maschinenfabrik, the largest manufacturers of foundry plant in Europe, and to the foundry of Heinrich Lanz, where the Perlit Process was invented and where the washing method of fettling castings is in vogue.

The bulk of the party returned on Sunday night to England, fully satisfied that the trip had been both interesting, pleasurable and profitable.

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List of Visitors taking part in the Visit to Düsseldorf, September, 1929.

W. H. Bateman (Audley Engineering Company, Limited), Newport, Salop.
J. Cameron (Cameron & Roberton, Limited), Kirkintilloch.
C. E. Carr, Birmingham.
F. J. Cook, Birmingham.
W. J. Dawson (Hadfields, Limited), Sheffield.
V. C. Faulkner (THE FOUNDRY TRADE JOURNAL), London.
Mrs. Faulkner, London.
S. W. B. Flavel (Sidney Flavel & Company, Limited), Leamington.
J. E. Fletcher (British Cast Iron Research Association), Birmingham.
J. W. Gardom (Bagshawe & Company, Limited), Dunstable.
C. F. Geary (British Thomson-Houston Company, Limited), Rugby.
H. Gresham (Heatly-Gresham Engineering Company, Limited), Letchworth.
J. M. Primrose (Grangemouth Iron Company), Falkirk.
J. C. Rhodes (John Rhodes & Son), Castleford.
G. H. Rhodes (John Rhodes & Son), Castleford.
A. J. Richman (Ransomes, Sims & Jefferies, Limited), Ipswich.
N. D. Ridsdale (Ridsdale & Company), Middlesbrough.
A. Roebuck (Hadfields, Limited), Sheffield.
W. Roxburgh (British Thomson-Houston Company, Limited), Rugby.
G. D. Russell (Mitchell, Russell & Company, Limited), Bonnybridge.
W. E. Sample (Audley Engineering Company, Limited), Newport, Salop.
J. Shaw (Brightside Foundry & Engineering Company, Limited), Sheffield.
H. Sherburn (Richmond Gas Stove Company), Workington.
R. H. Smith (Smith & Company (South Shields), Limited), South Shields.
R. L. Smith (Vickers-Armstrongs, Limited), Erith.
G. B. Wallwork (Henry Wallwork & Company (1920), Limited), Manchester.

Grantham Foundry Presentations.

Mr. John Tinn, O.B.E., who has just retired from the position of industrial works manager at the firm of Messrs. Ruston & Hornsby, the Spittlegate Ironworks, a position he has occupied for the past 33 years, has been made the recipient of handsome presents from the directors, staff and employees. The gifts consisted of a cheque, a gold-framed testimonial and an album of views of the works. The ceremony was presided over by Mr. A. R. Bellamy (director), and other representatives of the firm present included Messrs. V. W. Bone (works director of the Lincoln branch of the firm), W. Haynes (secretary), T. H. Edwards (works manager), T. McGlashan (assistant works manager), and Alderman F. Weekley, J.P.

Mr. R. H. Grantham, one of the oldest foremen at present with the firm, said that during Mr. Tinn's association with the firm no fewer than 1,128 apprentices had been entered, and 200 of them had received a special prize of a "plumb bob," with their name and date of service stamped upon it, these being given as a token of their special ability and keenness to get on with their jobs. Many of these men were now filling positions of trust at home and abroad and were all proud of their "plumb bobs." He asked Mr. Tinn to accept from him a gold-plated "plumb bob" inscribed, which would make a fitting companion to the 4-inch rule he had carried in his waistcoat pocket for 50 years, and by accepting it he would become a life member of the unique order of "Plumb bobs."

A GROUP OF B.C.I.R.A. MEMBERS AT THE ENTRANCE TO THE ZIMMERMANN WORKS.

C. W. Hampton (C. & J. Hampton, Limited), Sheffield.
A. Hodgson (G. Garner & Sons, Limited), Manchester.
C. H. Kain (Lake & Elliot, Limited), Braintree.
C. W. Kent (Henry Wallwork & Company (1920), Limited), Manchester.
C. J. Lake (Lake & Elliot, Limited), Braintree.
J. C. Leith (Smith & Wellstood, Limited), Bonnybridge.
F. W. Lewis (Fraser & Chalmers, Limited), Erith.
Mrs. Lewis, Erith.
A. D. Mackenzie (Mackenzie & Moncur, Limited), Edinburgh.
J. Marks (Ham, Baker & Company, Limited), Birmingham.
H. C. Marshall (Gestetner, Limited), London.
E. Millington (London Midland and Scottish Railway Company), Derby.
J. Mitchell (Mitchell, Russell & Company, Limited), Bonnybridge.
F. K. Neath (British Cast Iron Research Association), Birmingham.
F. W. Neville (J. W. Jackman & Company, Limited), Manchester.
A. L. Norbury (British Cast Iron Research Association), Birmingham.
W. Orman (Davis Gas Stove Company, Limited), Luton.
G. B. Warner (J. W. Jackman & Company, Limited), Manchester.
E. Whitehouse (Heatly-Gresham Engineering Company, Limited), Letchworth.
D. H. Wood (Constructional Engineering Company, Limited), Birmingham.

Aluminium Paint and Factory Lighting.

Without any increase of glass areas or changes in their arrangement, added intensity of light sources or rearrangement of lighting fixtures, better natural illumination of one of the large foundry buildings of the General Electric Company, of Erie, Pa., has been secured through the use of aluminium paint. Only one coat, which was considered the equivalent of two coats of oil paint, was used, and this was sprayed on. The cost of application was 48 per cent. of that of an equivalent pigmented surface, and, since refinishing will have to be done at less frequent intervals, further savings are possible through reduced painting costs and avoidance of interference with production work. An added advantage of the aluminium paint is that it is highly resistant to lacquer fumes that are released in the shop, which is used for the construction and assembly of domestic electric refrigerators.

Contracts Open.

Broadstairs, September 23.—570 lineal yards of 4 in. dia. cast or spun-iron pipes and specials, for the Urban District Council. The Surveyor to the Council, Pierremont Hall, Broadstairs.

Richmond, September 23.—Cast-iron pipes and specials, for the Corporation. Mr. H. P. Williamson, water engineer and manager, Hotham House, Heron Court, Richmond, Surrey. (Fee £3 3s., returnable.)

Johannesburg, October 17.—150 50-ton high-sided steel bogie wagons (3 ft. 6 in. gauge), for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 8,455.)

Lourenco Marques, October 26.—Three steel platform wagons (gauge 1.067 m.), for the Tendering Department of the Treasury of Lourenco Marques. The Department of Overseas Trade. (Reference A.X. 8,470.)

Modern Jobbing Foundry presents Interesting Features.

COMBUSTION ENGINEERING LTD.

Possesses Largest Experimental Pulverising and Sieving Station in Europe.

Combustion Engineering, Limited, of Derby, is an associated company of International Combustion, Limited, London, which, in turn, is a subsidiary company of International Combustion Engineering Corporation of New York. This latter company has half a dozen large manufacturing establishments in the United States, two companies in France, one in Germany, and last, but by no means least, Combustion Engineering, Limited, of Derby.

This company negotiated with the Derby Borough Development Committee in 1921 for a suitable site, and building commenced early in 1922. The company actually commenced manufacturing the same year, the first cast in the foundry taking place, appropriately enough, on the Fifth of November. Early in 1923, the company were employing 500 hands, and these remained practically stationary until 1926, when a very large extension scheme was commenced, with the result that the works are now three times as large as they were upon completion of the first building scheme in 1922. The buildings alone cover an area of 6 acres, the stockyards another 6 acres. These are enclosed in 20 acres of land, which the company have fenced in and reserved for works development. Outside this 20 acres is another 35 acres of land which is owned by the company, and which indicates that the people responsible for the development of the company's affairs are fairly sanguine that other large building schemes will have to be undertaken in the very near future.

The general arrangement of the buildings is such that continuous extension schemes can be put through and completed in units without interfering with the admirable arrangements of the whole lay-out. The sections are comprised of Administration, General and Drawing Offices, Pattern Shop, Pattern Stores, Iron and Brass Foundries, Machine Shops and Assembly Bays, Boiler, Plate and Tube Shops, Stock Yards, Time Office, Works Entrances, Works and Staff Canteens. The foundry is a large building, with fine natural lighting and ventilating effects, and is capable of turning out 180 tons of castings per week. The average output from the foundry at the present time being about 150 tons per week. A very varied range of product is handled, and the company's manufactures are changing so rapidly that the foundry is, of necessity, to all intents and purposes, a jobbing foundry.

The pattern shop is particularly well equipped with lathes, planers, band saws, circular saws, sanders, and a Wadkin Universal wood-working machine. Its output ranges from metal pattern plates up to solid patterns for 12-ton castings, whilst, as loam moulding is extensively carried out, a section is devoted to the making of sweeping bonds. At the time of our visit, the foreman was initiating fairly large-scale experiments on the use of three-ply wood for pattern plates. These, with metal-reinforced corners, have every appearance of being a useful innovation for them.

An excellent system of pattern storage and recording has been instituted. It is controlled from a cabin situated between the pattern shop and the stores, and every pattern, no matter where its destination, must pass. So numerous are the patterns that have been accumulated since the inception of the company, that it is a full-time job for the storekeeper.

It is interesting to note that during a conversation with the managing director, Mr. R. Greenwood,* that after taking a decision as to obsolescence of patterns, he found that there was a call for 14 per cent. to be remade. We would expect that after, say, five years a similar action would materially reduce this figure, and in any case the cost of storing the 86 per cent. which he destroyed would probably amount to a larger sum than the remaking of the 14 per cent.

Foundry Buildings.

The foundry proper is 375 ft. long, and is divided into three bays, the centre one being 60 ft. wide and the sides 45 ft. The centre bay is spanned by a 15- and two 5-ton Royce overhead electric travelling cranes, whilst the side bays each carry two 3-ton cranes. These are supplemented by six 1-ton electrically-operated jib cranes. Transport is facilitated by the provision

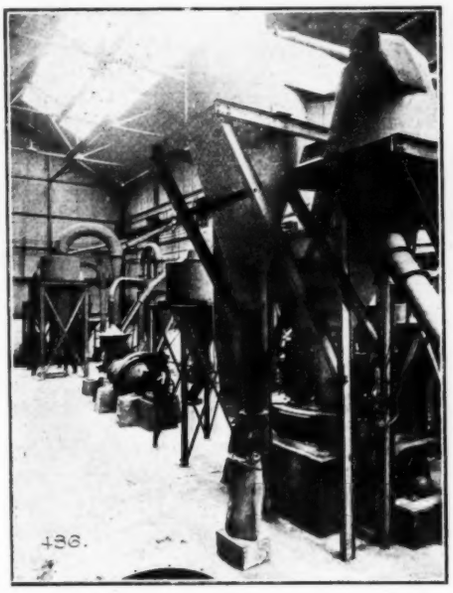

FIG. 1.—LARGE-SCALE TESTING STATION FOR PULVERISING AND SIEVING EXPERIMENTS.

of a number of intersecting cast-iron paved and grooved pathways for manœuvring the wheeled bogie ladles. At each intersection turntables are provided. These are of Mr. Greenwood's own design, and have proved very efficient. Provision is made for keeping sand away from the bearings, and a weekly cleaning ensures smooth working.

The raw materials are received from the L.M. & S. main line on to their private sidings, running along the bay housing the cupolas and sand-mixing plants. Alongside and between the siding and the foundry ample provision has been made for stocking the pig-iron, coke and sand. A fair amount of pig-iron scrap and coke can be stored on the cupola stage as it is of generous dimensions. Sand is shovelled direct from the wagon into bins provided with openings on the inside of the foundry adjacent to the sand-preparing plant.

* Mr. Greenwood has since resigned his position with the company to take up the position of Managing Director with Messrs. Craven Bros. (Manchester), Limited, of Redpath.

Melting Plant.

The hoist is capable of taking two large iron barrowloads of iron at each journey. All material is carefully weighed before charging.

The melting plant consists of one 7-ft. dia. cupola, by the Constructional Engineering Company; one 7-ft. cupola, by George Green, of Keighley, and one 4-ft. 6-in. dia. cupola, by the Constructional Engineering Company. The cupolas are blown by motor-driven Sirocco fans and high-speed motors, and the fans on the two large-diameter cupolas are interchangeable, so that either cupola can be blown by either fan (direct coupled to its own motor) and *vice versa*. The blower house is situated just beneath the charging floor, as is now common in modern practice. It also houses an air compressor, by Alley & MacLellan, for operating the various pneumatic machines and tools used in the foundry.

Before transferring the liquid metal to the wheeled bogie ladles or hand shanks, it is tapped into a large receiving ladle. The larger ladles, by the way, are of the Collin type.

By the side of the main melting plant is a cupolette used for melting alloy additions to be incorporated in special non-growth iron for furnace parts. The cupolas are firebrick-lined and patched with Lowick plastic refractory, using about 10 to 15 cwts. per day. Using the higher figure, this gives a percentage of repair material to throughput at 2.5, a figure comparable with the best German practice.

Sand Preparation.

The rapid extension of the foundry has caused the creation of two sand plants, but really without any disturbance of the general system. The cupolas are, roughly, centrally situated in its bay, and on one side there is a small non-ferrous foundry, the mould stoves, and two 6-ft. Simpson mixers for handling black sand and facing sands for both dry and green work. This plant consists of a pair of bucket-loading Simpson mixers, supplied by August's Muffle Furnaces, Limited, a Herbert disintegrator and two 6-ft. by 4-ft. Hum-mer screens. These latter are the first we have seen working on foundry sands, and we were impressed with the riddling efficiency. It will be remembered that the Hummer consists of wire mesh stretched at drumhead tension on a rectangular frame, and forming an adjustable inclined plane. Spanning the screen centrally and mounted on a bridge is an intensive vibrator. If the loading of the screen were so great that fine materal tended to leave with the lumps of hard cores, nails, gaggers and the like, then the angle of slope would be changed so as to retard progress somewhat. One of the chief features of the Hum-mer screen is that to our mind it lends itself so well to inclusion in any continuous method of sand preparation, whilst even the smallest foundry can at least save a little handling by substituting barrows for shovelling.

The second sand-preparing plant is in the same bay but on the other side of the cupolas near the core shop. Here core sands, and especially loam for cores, is made. Here, too, August's have furnished the mixing mills.

Core Making.

The core shop is of an unusual character, as the range is so wide. For small ones, linseed oil and sea sand mixtures are used, but this work is overshadowed by the large quantities of

really heavy loam cores that are turned out. Baking is effected in coke-breeze fired August's stoves. There is a battery of five which are 4 ft. wide by 7 ft. deep and a large one 11 ft. wide by 18 ft. deep.

Moulding.

Though this is virtually a jobbing shop, the management certainly does provide a good run for the segments for the stoker grates, and in this connection quantity production conditions are in vogue. One moulder, using one of the Universal System of Machine Moulding Company's latest productions, turns out, unaided, 200 boxes a day. This is a fine record, and one upon which we doubt whether any Continental foundry can improve. There are a fair number of other types of Ronceray machines, whilst a number of Adaptable machines are also rendering good service. In order to reduce somewhat the cross transport of sand, the bay remote from the cupolas and sand plant, which is largely devoted to machine moulding, two Coleman Prosama mixers are used. These are mainly used for aerating the sand on site for re-use with the machines.

A fair amount of dry-sand work is carried out, and for drying the moulds an August's stove, 15 ft. wide by 20 ft. deep, is in regular use.

The Non-Ferrous Foundry.

This self-contained department utilises a 200-lb. Morgan furnace and a 200-lb. furnace which the company designed and built, for melting a variety of metals and alloys, for making the various castings which one finds always to be associated with a works of this character, and also casts the metal pattern-plates.

Fettling and Despatch.

On one end of the moulding-machine bay (Fig. 2), extending also into the centre bay, is the fettling end. Wherever possible, rumbling is resorted to, and no less than nine barrels have been installed. These are supplemented by a line of single- and double-headed grinders. Before leaving the foundry, the sections for the boiler grates are gauged. For the heavier work, modern mechanical portable tools are used. The castings leave the foundry either to be stocked in an orderly stockyard or proceed directly into the machine shops.

An Experimental Laboratory.

During our visit we inspected an extremely interesting department which should be better known to the foundry industry. It is probably the largest testing station in Europe for ascertaining the cost of sieving or pulverising any material for any industry. Herein are installed Raymond & Hardinge mills, in association with cyclones of various and inter-connectable types. Moreover, what is of more intimate interest for the majority of our readers, is a Hum-mer screen, which, for instance, could be used for treating, say, steel-moulding sands. Primarily it could treat the rough sand, taking out the nails, brads, gaggers, and large lumps; then, by changing the screen, retain the re-usable sand whilst eliminating the fines. The power consumption and other working data can thus be obtained without interference with one's own shop routine. The screened sand would then be returned to the foundry ready for final preparation before use.

Welfare.

Few foundries are better served than Combustion Engineering, Limited. Its medical services and social activities are much appreciated by the employees. The works canteen, for instance, has accommodation for approximately 1,000 men, and at the time of our visit every seat was occupied at the luncheon hour. It is used for the many social functions organised by the Social Club, which latter is voluntarily maintained by the firm's employees and directly under their control.

Fig. 2.—View of Interior of Foundry from South-East.

Fig. 3.—View of Centre Bay from East End.

New Companies.

Loxdale Foundry, Limited, Loxdale Foundry, Price Street, Bilston.—Capital £2,000.

Electric Resistance Furnace Company, Limited, 17, Victoria Street, London, S.W.—Capital £5,000.

Lake George Metal Corporation, Limited, 1, London Wall Buildings, London, E.C.—Capital £1,000,000.

Metal Securities, Limited, 5, Copthall Buildings, London, E.C.—Capital £2,500 in 5s. shares. Secretary: A. Lyon.

C.O.M.E.T., Limited, 69, Fleet Street, London, E.C.—Capital £1,000. Steel founders. Directors: L. Van Mollekot and J. H. Cloetta.

Metallurgical Products, Limited, 16, Victoria Street, London, S.W.—Capital £20,000. Ironmasters, etc. Directors: F. W. Harbord and V. Harbord.

Direct Steel Process Syndicate, Limited, 3, Victoria Street, London, S.W.—Capital £7,500. Directors: Sir Basil Clarke, J. Whitby and A. K. Wilbraham.

Musgrave & Company (Dublin), Limited, 19, Eustace Street, Dublin.—Capital £500. Ironfounders, etc. Directors: A. F. Shillington, C. D. Armstrong and R. W. Hanna.

John Black (Motherwell), Limited.—Capital £7,000, to take over the Dalziel Engineering Works, etc., at Park Street, Motherwell. Directors: J. Black and G. R. Lindsay.

Book Review.

Wrought Iron and Its Decorative Use, by Maxwell Ayrton and Arnold Silcock. Published by Country Life, Limited, 20, Tavistock Street, Covent Garden, London, W.C.2. Price £2 2s. net.

The book is a work of art and carries an appeal, both practical and æsthetic, to art founders. It is admitted that castings are not dealt with to any extent, but a fair number of the designs carried out in wrought iron are quite capable of being reproduced in cast iron. They are, in any case, of great use when designing decorative cast work. In a book of this character the illustrations are of paramount importance, and the reputation of the publishers is of sufficient guarantee that the pictures have been reproduced to ensure the full expression of their artistic merit associated with clarity of detail.

To the reviewer, who so constantly has before him technical works for criticism, this book has afforded a considerable amount of pleasure on account of its literary merit, its clear bold type and the quality of paper and binding. To digress a moment, we do feel that there is a real message to the foundry industry. They, too, want a similar book to deal with their craft. Wrought iron is having a renaissance, whilst the art foundry is languishing. For the more simple designs, the foundry makes a pattern plate, which is capable of making reproductions *ad nauseam*, whilst unless drop-forging dies are used, wrought-iron work cannot be a repetition job.

This point is emphasised by the authors on page 178, when referring to the works of the Brothers Adam. It is interesting for founders to learn that the cast-iron palisade, which that great architect Wren put round St. Paul's Cathedral, cost about £448 per ton, counted on modern money basis.

The entrance gates to Chirk Castle are of particular interest for us as they are a combination of wrought iron, cast iron and lead, but we are not at all sure whether these are wrought or cast. Many establishments, carrying the title "foundry," merely smelt the lead ores.

The book contains about 200 9½ × 12 in. pages and 239 splendid illustrations, whilst the index is a model one, and materially in advance of those usually found in technical text-books. We specially recommend the purchasing of this book to our overseas readers, as it will make their next visit to Great Britain much more interesting, whilst for those at home, they may find unsuspected treasures in their own towns and villages.

Notes on the Damping-Down and Restarting of Blast Furnaces.*

By C. S. Gill (Consett).

Introduction.

The frequency with which during recent years† it has been necessary to shut down the furnaces, and await the settlement of the numerous trade disputes, has brought the whole question of the damping-down and restarting of blast furnaces very much to the front, and it is in the hope of encouraging a frank interchange of ideas on this important subject that this Paper has been written.

To many furnacemen, the period immediately following the renewal of operations, after a prolonged stand, is a time of stress and trial, in which hard and high tap-holes, together with other troubles—such as iron over the slag fall, and slag back in the tuyeres—play prominent parts, and if means can be found to eliminate these unpleasant features it will be to the advantage of all.

Each blast-furnace manager has his own system which he follows when it becomes necessary to interrupt temporarily the working of his furnaces, one which has been developed to suit the local conditions of the particular plant; but besides this on every such occasion the exact method to be adopted is dependent upon many factors, of which the three mentioned below are some of the most important:—

(a) Probable Duration of the Stand.

If the stand is to be of short duration there is no great difficulty in estimating the suitable coke blank, and, by the exercise of ordinary care, in seeing that this is quite definitely in the hearth before the blast comes off; and it is then possible to obtain perfectly satisfactory results on restarting. In the present Paper, however, the author has in view more particularly that damping-down which is necessary when the expectation is that the furnace will stand for an indefinite or prolonged period.

(b) Condition of the Linings.

Where the linings are known to be seriously damaged or worn, it becomes a matter of discretion as to whether they are in such a condition as to warrant the blowing-out of the furnace, raking out the material, and doing any repairs to the brickwork which might be necessary; in that case the furnace would be blown-in again in the same way as starting a new furnace. This is outside the scope of the present notes; but it is certain that, given reasonable care, it is possible to damp down and restart practically any blast furnace in such a way as to do a minimum of damage to the furnace, and to have it on to full output within a week of commencing the task of blowing-in, whilst at the same time escaping most of the trials usually associated with the process.

(c) Whether All or only a Proportion of the Furnaces are to be Damped.

If only a proportion of the furnaces is to be damped down it is possible to obtain exceptionally satisfactory results by adding a comparatively small blank of coke—with the usual precautions—and by keeping the downcomer valves open, to obtain a pressure of gas from the other furnaces during the stand. This quickly eliminates all combustion, and allows the furnaces to cool down in a condition which permits of the blowing-in being accomplished with practically no difficulty at all. Details are given later of a case in which this was done, and the furnace stood damped for eleven months.

The following are the general principles and methods adopted at the works with which the author is connected whenever a prolonged shut-down is necessary. No particular novelty is claimed, except that they have eliminated trouble from this usually troublesome undertaking.

Damping-Down.

Realising the futility of expecting an easy blow-in unless the damping-down be most carefully performed, very particular attention and study was devoted to this most vital part of the whole operation, with the result that it was felt that the condition to aim at in a perfectly damped furnace is one in which all reaction within the furnace is completely stopped. If it were possible to immediately quench the furnace after the last tap before the stand, blowing-in would be a simple matter, but as this is not practicable every endeavour must be made to approach as near as possible to this ideal. This means that all air must be excluded from the furnace during the period of the stand, and, even assuming the shutting-down has been satisfactorily performed, the ability or otherwise to accomplish this will be an important factor in the results obtained. This exclusion of air is essential if there be any ore in the charge, and should doubts be felt as to the possibility of effectively accomplishing this it is wise to omit ore altogether.

Air leaking into a furnace damped with an all-coke charge is wasteful of coke, but does not prevent a quick and easy blow-in. It is always wise to have an excess of coke rather than a deficiency, and, as just explained, this is the more necessary if the furnace be old or if the stand be for a prolonged period. But in any case sufficient coke should be charged to allow for a small proportion being burned before the blast is turned off, as this is a comparatively cheap price to pay to ensure that no fluid iron or slag is left in the hearth of the furnace to solidify and cause trouble when blowing-in. In those cases where ore is charged, the coke blank must be of such a size that it will prevent any reduced ore from reaching the fusion zone, or it will quickly percolate down into the hearth.

As is well known, the gas from a furnace which is being damped is very fiery and explosive, and it is usually risky to reach a condition where there may be a danger of the gas pressure falling owing to some furnaces being off whilst others are not yet ready to come off, so before commencing the damping a note was made from previous experience, or by calculation, of the exact number of rounds which should be necessary to complete the charge, and, where all the furnaces were being damped together, the blast was so adjusted that each furnace received its charge at a definite rate per hour—whilst maintaining the stock at the required level—which enabled all to be ready for taking off together. For the guidance of the frontside foreman, the number of beds of iron which he might expect by the time the coke was well down was also calculated, and if there had been any material shortage in the final cast it would probably have been decided to blow the furnace a little longer to make sure that no iron was left in the hearth.

For the final cast the tap-hole was specially prepared as low as possible and of the greatest area obtainable, usually two or more bars being driven side by side when tapping to ensure a good flush of iron and slag with as little resistance as possible. Every effort was made to remove all trace of fluid material from the hearth, and then the hole was stopped with specially prepared coal clay.

As quickly as possible after the blast was off, the "bags" were removed and the tuyeres stopped up tightly with fireclay, and sufficient of this clay was added to fill completely the tuyere and to give the joint a smooth surface covering between the tuyere and the cooler. This surface was then grouted, together with the whole of each tuyere arch, in order that any cracks on cooling could be immediately detected and resurfaced, and all brickwork was carefully pointed by bricklayers.

While this was being done, the downcomer valves, bleeders, and bell were also closed and sealed. Water on tuyeres and coolers was slacked right down, and the furnace was then allowed to stand without further attention, except regular examination for signs of cracks in clay or pointing, which were promptly attended to.

Blowing-In.

The following briefly describes, step by step, the process followed in a large number of instances, and in every case without exception the furnace quickly dropped into normal working.

Where the stand has been lengthy, and subject to the damping-down having been efficiently performed, the furnace at the time of starting up will be found to be practically cold in the hearth, which will be full of tightly packed coke, probably bound together by solid slag in the interstices. The hearth level may be slightly above normal working height, but not sufficiently so to cause any inconvenience. Ash will also be found in inverse proportion to the success of the precautions taken to prevent air infiltration during the stand.

It was realised that to turn on the blast to a furnace as described would mean that at any tuyere through which the blast could force a passage, melting would commence. The molten material, having nowhere to go below the tuyere, would be forced up by the blast into the openings above, until the pressure of blast became insufficient to hold up the weight. Then the slag would begin to run back into the tuyere—a condition which, of course, would rapidly become worse if the blast were taken off the furnace, and the whole volume of semi-molten material allowed to fill the tuyere, bag and gooseneck.

The remedy for that is to force the blast downwards, and so to provide room for the molten material, while also heating up the hearth to prevent it resolidifying, and to this end the first step was to break away the brickwork at the tap-hole. An opening, roughly 2 ft. sq., was made, and through this opening was raked any ash found, whilst the solid coke and slag was chiselled away till a large hollow space, perhaps 3 or 4 ft. in dia., was formed, connecting up to at least two tuyeres nearest to the tap-hole.

Whilst this was being done, the other tuyeres round the furnace were cleaned out, and any ash raked away. If only cold-blast was available for the blowing-in, an endeavour was made to bring hot coke down to both the hearth and the tuyeres, and when this was accomplished all the tuyeres were clayed up except the two, or at the most three, tuyeres near the tap-hole. The opening in the furnace at the tap-hole through which the cold material had been raked was bricked up, leaving a hole 9 in. wide and about 18 in. high. This was left open, and the blast was put on the furnace through the three open tuyeres at a pressure of about 1½ lbs. only.

A flame quickly appeared at the tap-hole opening, and this rapidly gained in intensity, bringing down white-hot coke to the opening, which was kept clear whenever there appeared to be a tendency for it to become choked. After some hours, slag began to blow from the hole and to trickle down the trough; the blast was then taken off, the hole cleared of the hot coke, etc., and the opening stopped up with specially coaly clay prepared for the purpose. This clay was not rammed right back, but the hole was just filled with it, with only sufficient ramming to

(*Continued on page* 211.)

* A Paper read before the Autumn Meeting of the Iron and Steel Institute.

† Written in 1926.

The Brackelsberg Furnace for Melting Cast Iron and Malleable Iron.

By Dr. P. Bardenheuer.

[Translated from "Die Giesserei."]

Some time ago, the Kaiser Wilhelm Institute for Iron Research was asked to carry out a thorough test of the coal-dust rotary furnace developed by Messrs. J. D. Brackelsberg, of Milspe, for melting cast and malleable iron. The satisfactory results of these tests, which show the new method of melting to mark progress both from the metallurgical and commercial standpoint, lead us to give a few details as regards the process of melting as carried out in the Brackelsberg furnace, since the process can be used equally well for malleable and grey-iron castings, but more particularly for high-quality cast iron.

The furnace consists of mild-steel sheet drum mounted on rollers and lined with refractory material. The 6-ton furnace is 16.4 ft. inside length and approximately 3.75 ft. inside diameter. The coal-dust flame enters the furnace at one of the ends; and the waste gases escape through an opening in the middle of the other end, which is also used for charging the furnace. The furnace is charged either by hand, or the charging end is upended with a crane and the charge, placed on a shute situated at a higher level, is slowly let into the furnace. The furnace is always charged afresh immediately after being tapped or after the slag has been run off, so that the heat of the furnace is extensively utilised. It is intended to convert the heat of the waste gases for pre-heating the blast, heating the ovens, etc., but it is not so utilised at present. A vital factor to the proper operation of the furnace is that the fuel be admitted uniformly, this being ensured by a special design of worm conveyor. The tapping hole is situated laterally in the casing, so that any desired quantity of the charge can be run off by suitably rotating the furnace. The slag is run off last of all. The blast is supplied by a high-pressure fan driven by a 12-h.p. motor, the blast pressure amounting to 8-in. to 14-in. water gauge. A ½-h.p. motor is required for rotating the furnace. During the process of melting the furnace makes to and fro movements, and, after everything is fluid, the furnace can be rotated completely. By fitting it with an automatic change-over switch, the furnace requires no special attention whilst melting operations are proceeding.

Melting Costs Detailed.

It takes about 2¾ hours to melt 4 tons of malleable iron (casting temperature 1,500 deg. C.), with a coal-dust consumption (coal containing 12 to 14 per cent. of ash) of approximately 15 per cent. The same quantity of grey cast iron (casting temperature, 1,400 deg. C.) takes about 2¼ hours to melt, with a coal-dust consumption of approximately 12 per cent. If the furnace is cold when the iron is charged into it, a "heat" takes about 30 minutes longer. In larger-capacity furnaces, correspondingly better results may be expected as regards the time of melting and the fuel consumption per ton of charge.

In order to get a clear idea of the melting process, a number of melts were followed in all their details, the results being utilised partly for drawing up complete material and heat balances. Only the most important figures will be given here.

The change in the composition of the iron in the furnace is shown by the following examples:—

(a).—Melting Malleable Iron.

—	C. Per cent.	Si. Per cent.	Mn. Per cent.	P. Per cent.	S. Per cent.
Charge	3.38	1.12	0.13	0.064	0.068
Product	3.27	0.87	0.11	0.060	0.067

(b).—Melting Grey Iron.

Charge	3.44	3.91	0.57	0.075	0.035
Product	3.26	3.51	0.50	0.081	0.039

The total loss amounted in the first case to 0.62 per cent., and in the second case to 1.22 per cent. The amount of iron converted into slag, viz., 0.15 and 0.16 per cent. respectively, is extremely small, while the decrease of carbon is usually a desirable feature. The loss of silicon and manganese is no greater than it is in the cupola, but much lower than in the ordinary reverberatory furnace. With the burner directed horizontally or slightly upwards, no sulphur is absorbed from the fuel. The whole of the sulphur and a large, if not the largest, part of the ash leaves the furnace with the waste gases.

A high percentage of sulphur, if desired, can easily be obtained by tilting the burner on to the bath.

Piping Reduced.

The process of melting down the iron is accelerated by the rotary motion of the furnace. As soon as the iron is melted, it drops below the protective layer of slag, and is thus quickly removed from the influence of the gases of combustion. This is a considerable advantage over the cupola process, where the drops of iron, in a fine state of division, have to travel a long way through a strongly oxidising atmosphere when the iron is at a high temperature. It is important that the liquid iron be protected at the proper time from the effects of gases, inasmuch as the capacity of liquid iron for dissolving gases is much greater than that of solid iron, and increases still further with increasing temperature of superheat. Due to being quickly melted and protected in the liquid state by the slag, iron melted in the rotary furnace does not liberate gas bubbles even after being considerably superheated in the ladle; it has an extremely low viscosity and gives dense and sound castings. The tendency of the castings to "pipe" is much less than in cupola iron of the same composition.

From corrected readings on the optical pyrometer (Pyropto of Hartmann & Braun), and measurements made with platinum couples on tapping samples, in the case of malleable iron, the approximate tapping temperature of the iron throughout was 1,500 deg. C. It will be possible to increase the temperature much higher than this without preheating the air, simply because a high combustion temperature is one of the advantages of coal-dust firing, as the finely divided coal can be burnt without any appreciable excess of air.

According to J. F. Shadgen,* coal-dust burning gives flame temperatures to 2,000 deg. C. without the air being pre-heated. The possibility of getting very high bath temperatures in the furnace without at the same time causing the iron to be oxidised or to absorb gases, is a very valuable feature for the production of high-quality cast iron.

Low Carbon and High Strength.

Research work on cast iron during the past few years has clearly shown that the best strength figures can be obtained in cast iron primarily with a low carbon content and by getting the graphite finely distributed. Both these conditions presuppose a high melting temperature, because (1) the melting temperature of iron increases considerably with decrease in carbon content, and (2) the original graphite particles are dissolved more quickly, the higher the temperature and the lower the total carbon; and it is this second condition that determines the development of the graphite in a finely divided form.

The first experimental melts of low-carbon high-quality cast iron in the Brackelsberg furnace gave an iron containing 2.7 per cent. C. and with a tensile strength of roughly 19.04 tons per sq. in. For testing the casting properties of the metal produced in the furnace a wedge specimen terminating in a fine taper, together with a box of sewing machine feet with sections down to 1.0 mm. was cast. The test casting came out sharp-edged to the very last (sewing machine) foot. This test ought to be sufficient to demonstrate that the furnace is suitable for the production of low-carbon high-quality cast iron, and one which will meet the strictest requirements in regard to castability.

High Elongation for Malleable.

Malleable iron affords another example of the quality of the products melted in this furnace. The Materials Specification for ordinary malleable cast iron lays down a minimum elongation of 2 per cent., the minimum for high-quality white-heart malleable being 4 per cent. The white-heart malleable melted in the Brackelsberg furnace has a mean elongation of 18 per cent., with a tensile strength of approximately 24 tons per sq. in.* The pig-iron used for the purpose is exclusively of German origin. By using a high-quality, pure charge, the mean elongation rises to approximately 25 per cent. for white-heart malleable. The example demonstrates that it is possible to obtain with the furnace castings exhibiting the best attainable properties.

The rotary motion of the furnace gives a perfectly uniform composition of the bath, and undoubtedly contributes to the acceleration of the process of complete dissolution of the original graphite in the iron.

Owing to the rotary motion of the furnace, the furnace lining wears only slightly and uniformly. Practical experience has shown that, when using a good silica plastic refractory containing about 95 per cent. of SiO_2, the lining will hold up for about 200 melts, and often more, repairs not being necessary in the interval.

Due to the low fuel costs and the saving in wages for running the furnace and repairing it, the melting costs in the Brackelsberg furnace are much lower than in any other process for melting iron.

A few further points must not be overlooked in comparing the economy of the different melting processes. As regards wasters, any discard due to the quality of the iron is practically eliminated in Brackelsberg furnace castings. Hitherto no deleterious effects have been observed upon the iron melted by using any classes of pig-iron such as give rise to serious failures in the cupola. The possibility of using any desired percentage of gates and risers and scrap iron, or steel scrap, for reducing the carbon content in producing high-strength iron means that the process is still further cheapened.

Advantages Summarised.

Despite these facts, the greater advantages of this method of melting have a metallurgical basis. They may be briefly summarised as follows:—

1. The rotary motion of the furnace accelerates melting, gives a uniform composition and a uniform temperature of the iron melted, besides promoting the solution of the graphite in the charge.

* "Iron Age," 109 (1920), pp. 457-61.

* These figures, which were determined under practical conditions, were confirmed when the experimental data were tested and verified.

2. The iron bath is protected by the slag covering from the chemical effects of the fuel and the furnace gases; carbon and sulphur are consequently not absorbed. The loss of the other alloy elements is small, and the iron loss practically negligible.

3. The slag covering fully prevents the bath being saturated with gases from the furnace atmosphere. The oxides which get to the bath during the melting process can be practically all reduced or can rise into the slag during the subsequent heating of the bath. Due to these facts, the melted iron contains very little gases and oxides; it is characterised by a very low viscosity, and gives sound and dense castings.

4. Any desired chemical composition of the iron can be adjusted simply and with certainty. The extra costs for expensive special pig-irons can be very largely saved.

5. The high furnace temperature easily attainable by the coal-dust flame enables the carbon content to be decreased considerably and the more intense heating of the iron, which this involves, to be obtained. These factors enable any graphite nuclei to be completely dissolved, thus affording the essential fundamental conditions for the production of low-carbon high-quality cast iron with the graphite in a finely divided condition.

DISCUSSION.

The Deputy-Chairman said that the applause had shown Dr. Bardenheuer how keenly interested the audience were in his statements as to the astonishing new performances of the furnace.

Dr. Thaler (Niederreissbach) pointed out that it was merely stated that a covering of slag is present which protects the iron. He asked for information as to the nature of this slag.

Dr. Bardenheuer, in reply, said that lime was added precisely in the same way as in other processes, *e.g.*, the cupola process. Large quantities of sand got into the furnace with the pig-iron and must be converted into slag.

Dr. Thaler said he presumed that a considerable amount of oxidation occurred during the process of melting.

Dr. Bardenheuer said that on the contrary, the oxidation during the actual melting process was very slight. In the reverberatory furnace, where material that was lying quiescent had to be melted and which could not be thrown on to the other side, melting took longer. A high degree of oxidation did not take place as otherwise this would show in the analysis.

Director Stähle (Stuttgart) said that he understood that the melting period of 2½ hours for 4 tons, which he thought to be a long time, and asked whether, without detriment to the quality of the material, it would not be possible to attain the objective more quickly by pre-melting the charge in the cupola and then treating it in the coal-dust furnace.

One-Third the Cost of Cupola Melting.

Dr. Bardenheuer pointed out that this would make the process very expensive, as the melting costs in the Brackelsberg furnace were only about one-third of the costs for the cupola. It was only necessary to heat the liquid iron half an hour longer to get a high casting temperature. With larger charges, the furnace yield per hour would, of course, be raised considerably. The same conditions would obtain as in the reverberatory furnace, or particularly in the open-hearth furnace, where larger furnaces give better performances than small ones.

Costs Queried.

Engineer Schmid said that Dr. Bardenheuer had stated that the melting process described by him costs only a third of the cupola melting process. It would be interesting to know how he arrived at this ratio. He got a much less favourable ratio when he assumed a consumption of 15 per cent. coal-dust and a price of 22s. per ton of prepared fuel.

Dr. Bardenheuer stated that when he made his tests at the Brackelsberg foundry, the coal available there contained 12 to 14 per cent. of ash, and cost 9s. 10d. a ton. The foundry there paid 27s. per ton for coke. At the time when malleable iron was still being melted in the cupola, 18 to 20 per cent. of coke was being used. He used here approximately 15 per cent. of dust for malleable iron, and he had even used much less dust than this in his latest experiments.

Engineer Schmid insisted that the price of bituminous coal-dust depended very largely on the way it was produced. In a Paper read last year on the "Imperial Auxiliary Coal-Dust Firing" as applied to cupola operation, Dr. Bardenheuer gave the price of coal-dust at 28s. per ton.

Dr. Bardenheuer: That is quite impossible.

Engineer Schmid, continuing, said that in Berlin it was estimated that treated lignite dust costs about 18s. to 19s. per ton. At this price, and allowing for the cost of compressed air for the melting process which Dr. Bardenheuer described, the melting costs would work out at the same as those for the cupola-melting process.

Dr. Bardenheuer thought this was absolutely impossible, for fine coal costs slightly over 12s. Fine coal can also be obtained from the smaller non-syndicated collieries, which supply at much cheaper prices. The experiments had been made with a dust which is drawn from the pits—a comparatively low-grade product. This explained its extraordinarily high ash content.

Director Keller asked whether the author did not think that the percentage of 18 to 20 per cent. which he estimated for the cupola process was not very much on the generous side.

Dr. Bardenheuer, in reply, said that it must be remembered that we are here concerned with a malleable iron which is produced at the low daily output of 5 tons. This made the melting costs comparatively high. A fairly large malleable iron foundry turning out 50 tons of castings a day reckon their melting costs at 13s. 2d. per ton of iron, as compared with 16s. 9d. in smaller foundries producing 5 tons a day.

Dr. Jungbluth asked whether the melting costs were for liquid material.

Dr. Bardenheuer said they included liquid material, fuel costs and wages.

A Competitive Furnace.

Herr Mehrtens (Berlin) said the interest in drum furnaces of the oil-fired type was on the increase. He had seen at the Wülfel ironworks a drum furnace which, due to being supported eccentrically, enabled the bath to be shaken while it was making the rotary movement. The furnace of the Buess type was mainly intended for high-quality cast iron. He reserved the privilege of reporting elsewhere on the operating results of this and similar drum furnaces.

Dr. Bardenheuer, in reply, insisted that the simple shaking movement without eccentric bearings was fully sufficient for obtaining an absolutely uniform material. He should simply like to mention there that Messrs. Brackelsberg had very large orders in hand for curves and cams for sewing machines. These castings must neither crack nor mark when used in the machines. In these curved sections a roller operates through a slot. This stressing makes high demands on the uniformity of the material. He had found to his great surprise that well-known sewing-machine manufacturers, who had their own well-equipped foundries, were sending all their orders there (*i.e.*, to Brackelsberg), as they were not able themselves to manufacture a sufficiently uniform material in their cupolas. (Cries of: "Malleable castings?") No, grey iron. Very high prices were paid for these parts.

Messrs. W. F. Hardy & Company, iron and steel merchants, have removed from 73, Surrey Street to 169, Norfolk Street, Sheffield.

Notes on the Damping-Down and Restarting of Blast Furnaces.

(*Continued from page* 209.)

keep it firm, and through the clay was driven a 2-in. sq. mild-steel bar in about the centre of the opening, and the blast again turned on.

As the melting zone in the hearth extended, the tuyeres which had been clayed up were opened out gradually from front to back till all were fully open. After blowing for 1½ hrs. with a blast pressure of 2 to 3 lbs., the hole was pared below the bar and the furnace tapped, any slag being run into the ladle and the iron on to the beds. This was repeated at gradually extending periods as the capacity of the hearth increased, and a hard hole was rarely experienced; it was only after probably 24 hrs. that the slag notch was opened and slag run over the fall, by which time the furnace was working normally.

Table I.—*Details of the Damping-Down and Restarting of Two Blast Furnaces.*

Furnace No.	1.	5.
Condition of lining	Good	Moderate.
Size of coke blank	121 tons	37 tons.
Details of ore in charge	Nil	Cwts. 10 rounds { Coke, 45; Ore, 50; Lime, 11 Filled up with { Coke, 45; Ore, 55; Lime, 12
Length of stand	175 days	338 days.
Furnace	Sealed and isolated	Open to gas from other furnaces.
State of material in hearth at close of stand	Clean. Free from ash. Hot	Clean and soft. Free from ash. Cold.
Blast on at	9.25 a.m., Dec. 8	6.20 a.m., May 27.
Pressure	¼ lb. at furnace	1½ lbs. at furnace.
Number of tuyeres	Three tuyeres	Three tuyeres.
Temperature of blast	Practically cold	1,500 deg. F.
Gas into main flue	11.10 a.m.	8 a.m.
Hole clayed up first	3.15 to 3.45 p.m.	11 to 11.20 a.m.
Slag to ladle	6.15 p.m. Hot grey slag	12.50 p.m.
First iron on beds	6 a.m., Dec. 9	
Last tuyere opened	11 a.m., Dec. 9	3.15 p.m., May 27.
Slag notches opened	4.30 p.m., Dec. 10	10 a.m., May 28.
Cast analyses. Silicon, per cent.	Dec. 9: 7.02, 7.34, 9.28, 9.04	May 27: 5.94, 4.40, 4.34
	Dec. 10: 6.80, 5.60, 5.14, 4.36, 3.00, 2.52	May 28: 5.80, 3.86, 4.56, 3.50, 3.74, 3.70
	Dec. 11: 3.76, 2.80, 3.22, 3.48, 3.46, 3.38	May 29: 5.16, 4.32, 5.30, 5.04, 4.32, 4.56
	Dec. 12: 2.78	May 30: 3.60

Table I contains details of the damping-down and restarting of two furnaces, which serve to illustrate the results obtained by the above methods. Both furnaces were making sale iron, so no effort was made to reduce the silicon quickly, especially in the case of Furnace No. 5, when siliceous iron was urgently required, but had low-silicon iron been required there would have been no difficulty in speeding up the increases of ore. It is to be observed that within 48 hrs. No. 1 furnace was in a normal condition, whilst No. 5 furnace was normal within 28 hrs. of putting the blast on, and in no instance was the slightest trouble experienced.

Summary.

Damping-Down.—(1) The coke blank must be of such a size that it will prevent spongy iron from reaching the melting zone; (2) the furnace should be thoroughly drained of all molten metal or slag at the last tap before shutting down; (3) air infiltration must be prevented.

Blowing-In.—(1) Before turning on the blast make room below the tuyeres for the molten material; (2) get the maximum heat possible to the hearth and tap-hole; (3) blow up through the tuyeres nearest the tap-hole, opening the other tuyers gradually as space in the furnace increases.

Iron and Steelworks and Auxiliary Plant of the Consett Iron Company, Limited.

ONE OF THE WORKS VISITED BY THE IRON AND STEEL INSTITUTE.

The Consett Iron Company, Limited, is the modern development of the Derwent Iron Company, which was formed in 1840. This Company erected blast furnaces and rolling mills. They obtained leases for most of the ironstone in the district, as also several large royalties for coal. The old Derwent Iron Company were heavily involved with the Northumberland and Durham District Bank, which in 1857 stopped payment, and of course steps were taken to protect the Company's property for the benefit of the creditors. Subsequently the works were disposed of to a number of shareholders of the Bank, who formed a company under the style of the Derwent and Consett Iron Company, Limited. This Company, however, was unable to complete the purchase, and in the course of a couple of years the property was again put up for sale, when it was purchased by the present Company, who were registered in April, 1864, under the style of the Consett Iron Company, Limited.

When the present Company took over, the property included 18 blast furnaces, of which seven were at Consett, seven at Crookhall and four at Bradley, producing about 80,000 tons of pig-iron per annum, whilst the puddling furnaces, plate, angle and bar mills were equal to the production of from 40,000 to 50,000 tons of finished iron per annum. At the time of the formation of the present Company only six of the furnaces were in blast. There were 99 puddling furnaces at Consett and 31 at the Bishopwearmouth Iron Works, which had been acquired by the original Company. In 1866 the Consett Company acquired the tin-plate mills of Richardson & Company, which lay to the north of the main Consett works; there were thus added to the original works 27 puddling furnaces and three plate mills. A colliery was also acquired, which was in closer proximity to the works than their own pits.

The works at Bishopwearmouth were soon dismantled and the operations centralised at Consett. The manufacture of tinplates was discontinued and the works used for the production of iron plates. The first steel furnace was put down in 1882 for the production of open-hearth steel, as soon as it became apparent that steel plates would supersede iron plates for shipbuilding purposes.

The change-over from iron to steel was inevitable, and as extensions were made to the steel plant from time to time, puddling furnaces were put out, and to-day the Consett works are devoted solely to the production of pig-iron and the manufacture of finished steel.

The original blast furnaces each produced about 239 tons per week. In 1865 a larger furnace was added, which produced about 340 tons per week. Obviously these small furnaces were not adapted to modern requirements of the trade, and the growing demand for iron rendered the reconstruction of the blast-furnace plant necessary. This work was put in hand in 1865, and by 1873 the whole of the original furnaces had been dismantled and replaced by six larger ones. A further furnace was built in 1880, whilst more recently an additional furnace has been erected.

The present blast-furnace plant comprises seven furnaces, each 55 ft. high and 10 ft. hearth diameter; height to top of boshes 18 ft. 6 in.; dia. at top of boshes 18 ft.; dia. of throat, 14 ft. 6 in.; and bell with 10 ft. 6 in. opening. The more recently erected furnace has a height of 75 ft. and a hearth dia. of 12 ft. 6 in., and has an output capacity of 2,500 tons per week. Fig. 1 is a view of the blast-furnace plant.

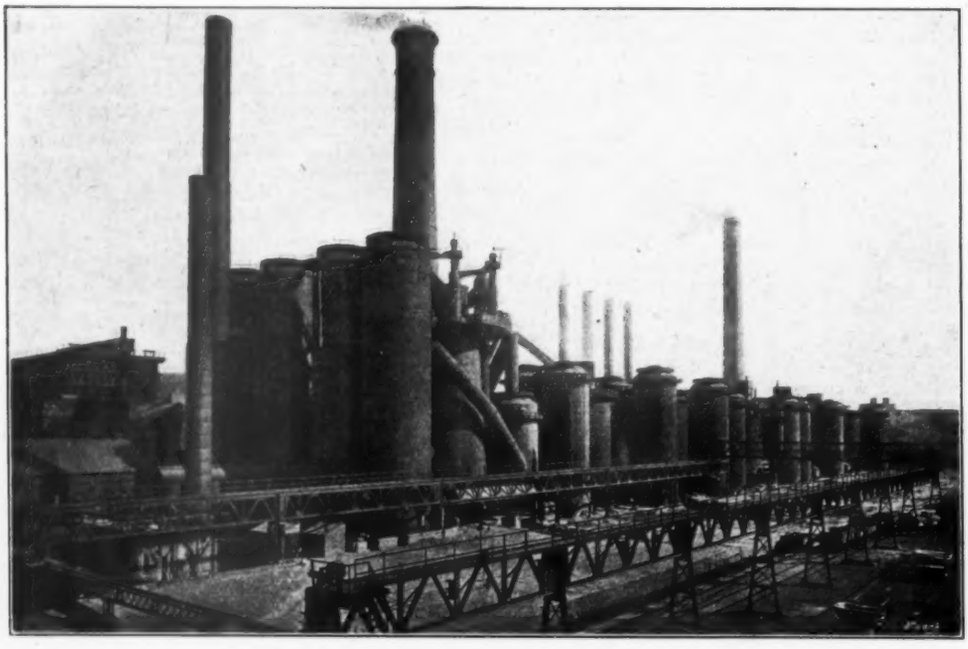

Fig. 1.—View of Blast-Furnace Plant.

EXTENSIONS TO THE PLANT AND RECONSTRUCTION OF THE STEELWORKS AND MILL PLANT.

In order to cope with future demands the Consett Company determined to lay down plate mills, and at the same time to reconstruct and re-condition, so far as possible, the whole of the existing plant. The scheme which was formulated in 1923 was as bold as it was comprehensive. It was undertaken at a time of exceptional industrial depression, when there seemed little to justify confidence in the future of the industry, though, obviously, advantage should be taken of slack periods to carry through work of such character, so that it may interfere as little as possible with the ordinary operation of the works and at the same time be completed so that full advantage can be taken of an improving market.

The scheme of reconstruction has now been carried to completion. As existing to-day, the Consett works are one of the largest and amongst the best-equipped steelworks in the kingdom; they are also one of the most self-contained as regards supplies of raw materials—ore, limestone, coal, coke, bricks, etc.

BLAST FURNACES.

In the meantime, except for certain modification in details, the blast furnaces have not been interfered with, as on the whole they are working fairly well; their main disadvantage would appear to be they are not high enough at the tapping holes, excepting the last furnace erected, to allow of the use of hot-metal ladles; consequently the steel furnaces are charged with cold metal.

The pig bed is served by a Wellman 7½-ton magnet crane, which lifts the combs and feeds them to the breaker, from which they fall automatically into wagons for conveyance to the melting shop.

The furnace blowing plant has now been entirely remodelled, comprising three Parsons turbo-blowers, one of 30,800 cub. ft. per min. and two of 21,000 cub. ft. per min. each at 10 lbs.; whilst recent additions are two Fraser & Chalmers turbo-blowers, each rated to furnish 35,000 cub. ft. of air per min. at 20 lbs. gauge pressure. At present one of these units is isolated to serve the large blast furnace at 12 to 14 lbs. pressure, and the other unit, working at 5 to 6 lbs., runs in parallel with the Parsons blowers. The whole of the blower sets are run condensing, the large units to Mirrlees Watson surface condensers, with Mather & Platt circulating pumps and multi-jector- (steam jet) air extractors. The circulated water is pumped to a Davenport cooling tower, which can be assisted, when necessary, by a cooling pond fitted with Harrison sprayers.

The old blower house, which formerly accommodated five vertical blowing engines, has been converted into a very serviceable power house by the insertion of an additional floor and re-roofing. Obviously, it is not an easy matter to find space for a new house in the lay-out of an old blast-furnace plant, but the difficulty has been overcome in a reasonably convenient manner by placing the condensers on the ground floor, the prime movers on the first floor, and the switchgear, etc., on the second and top floor.

The power plant comprises two Belliss-English Electric Company 3,000-kw., 3-phase turbo-alternators, 3,000 to 3,300 volts, 40 cycles, this last enabling them to run in parallel with the system of the Newcastle Electric Supply Company, Limited. There is 1,000-kw. d.c. geared set, consisting of an English Electric turbine running at 3,000 r.p.m., connected through David Brown reduction gear to an English Electric 1,000-kw. 500 to 550-volt, d.c. generator running at 600 r.p.m. There are two 1,500 kw. rotary converters; the incoming supply voltage is 3,000 and the d.c. output 480 to 525 volts, the machines being level compound-wound within this voltage range. Steam is raised in 21 Babcock & Wilcox and 8 Stirling boilers, which are set in pairs and have an aggregate rated evaporative capacity of 290,000 lbs. of water per hr. Steam is raised at

160 lbs. and superheated to give dry steam at the prime-mover stop valves. The whole of the boilers are fired with blast-furnace gas, plus any surplus of coke-oven gas beyond the requirements of the steelworks.

The question of erecting new blast furnaces with gas-cleaning, etc., is under consideration.

STEELWORKS.

Melting Shop.

The new melting plant has taken over the duties of (1) the West melting shop, which was built in 1881; (2) the East melting shop, built in 1887; and (3) the North melting shop, built in 1890 to 1893. The new shop is 884 ft. in length. The charging bay, 58 ft. wide, and the casting bay, 65 ft. 3 in. wide, are covered by a single span; a separate span covers the stocking bay, which is 60 ft. 3 in. wide. This last bay is served by three 14-ton cranes which are equipped with magnets for loading the charging boxes and hooks for raising the cradles of four charging boxes to the charging platform. The charging boxes have steel-plate sides with hematite-iron ends, and are made by the Company.

The melting plant consists of five 75-ton acid open-hearth furnaces and four 75-ton basic furnaces, and they are served by three 3-ton Wellman charging cranes, two of which are each fitted with 5-ton auxiliary hoists. The furnaces are fired with a mixture of coke-oven and producer gas. The producer gas is generated in a battery of 18 Chapman producers, the mains being fitted with gas-pressure regulators. The waste gases from each furnace are passed through a Woodison waste-heat boiler; these boilers are in series with the boilers at the blast furnaces.

As already stated, cold metal is used, the time taken from tap to tap being under twelve hours, and the average output of furnaces is approximately 950 tons per week. The total fuel consumption, including coal and coke-oven gas reduced to the coal equivalent, is equal to 5¼ cwts. per ton of ingots.

The casting bay is served by three Wellman cranes of 100 tons capacity, each crane fitted with a 25-ton auxiliary grab. All ingots are cast on cars, the ingots ranging in weight from 2 to 4 tons for the bar mill and from 5 to 12 tons for the plate mills. In addition to the stocking bay under roof, there is a scrap-stock yard of the open-gantry type 360 ft. long by 80 ft. span, which is served by two 14-ton magnet cranes. From the casting bay the ingots are conveyed on cars to the stripping houses and soaking pits of the plate and angle mills respectively.

Fig. 2 shows a view of the charging side, and Fig. 3 (page 375) a view of the tapping side, of the open-hearth plant.

Fig. 2.—Open-Hearth Charging Stage.

Coke Ovens.

The Company were already large producers of coke, having a battery of 75 ovens at Langley Park and a double battery of 105 ovens at Templetown. In order, however, to meet the increasing demand for coke at the blast furnaces an extension to the coking plant became necessary. This indeed formed a portion of the scheme which has now been completed. A site was chosen adjacent to the steelworks so that the surplus gas could be turned to profitable account.

The Coppée Company (Great Britain), Limited, erected a battery of 60 Wilputte ovens, complete with Coppée by-product and benzol plants, which were started up in March, 1924. This was not only the first installation of the Wilputte oven in this country, but it was also the first built of silica bricks and shapes made on site. It speaks well alike for the design and construction of the oven, as well as for the material used, that after upwards of five years' continuous service the oven walls remain in perfect condition.

Templeton Silica Brickworks.

Since their erection, constant changes have been made in the auxiliary plant of the silica brickworks of the Company, when alterations have appeared to offer any possibility of improving the production or speeding up output. The ganister is now delivered to the works by aerial ropeway, which was designed by Ropeways, Limited, the whole of the steel and constructional work being carried out by the Consett Company. The rope flight is 4 miles in length and its capacity 120 tons per shift. It is driven by a Met.-Vic. 35-h.p. high-torque motor.

The grinding plant comprises three mills built by the Brightside Engineering Company, Limited. The rolls are adjustable on their beams so as to give varying speeds, and the shafts are also adjustable to take various sizes and weights of rolls. The mills, each being driven by a 100-h.p. motor, weigh approximately 30 tons. The whole of the grinding plant is being totally enclosed, and dust will be extracted therefrom by a Sirocco fan.

The drying plant has been modified and now comprises four Proctor dryers, each with chambers 48 ft. by 20 ft. and heated by steam pipes placed below the floor level. The air is circulated by 10 fans to each dryer, the fans being staggered five on either side of the chamber. A small auxiliary fan is employed to exhaust the moist air. The cars are pulled through the chamber by a link chain, which engages with the framework of the cars. The arrangement is such that the heat in the chamber is graduated, the heat immediately at the entrance being moist, which ensures that the bricks shall be thoroughly warmed through

(*Continued on page* 214.)

Fig. 3.—View in Open-Hearth Casting Pit.

Foundry Purchasing—XXXV.

By Eric N. Simons.

Buyer and Storekeeper.

The buyer should not treat the storekeeper as if he was merely a clerk or humble subordinate. Whether he cares to admit it or not, it is unquestionable that the storekeeper can, if he so desires, do a great deal in a quiet way to nullify the buyer's work, or at least to hinder and confuse it. Much depends, therefore, upon the buyer's ability to win the respect and co-operation of his storekeeper. He should trust him to carry out his functions efficiently, and should not too obviously supervise and control him. The able buyer knows how to ascertain the truth in regard to the efficiency or otherwise of storage work without making himself a conspicuous figure in the stores. At the same time, if convinced that stores management is suffering as a result of negligence on the storekeeper's part, the buyer must not hesitate to call the offender to order, since if the storekeeper is responsible to him for the conduct of stores, the buyer himself is responsible to his employers for the buying and storing of goods as a whole.

Suggestions which are received from the storekeeper should be given a careful hearing, and should not be lightly dismissed. If, for various reasons, they are found impracticable, a full explanation of the why and wherefore should be made. Otherwise, there may be left some resentment in the storekeeper's mind that will find expression in action. And in this connection it must be pointed out that, while the buyer has authority to check by drastic action any negligence or insubordination on the storekeeper's part, his true work is to prevent the possibility of any such offence by making the storekeeper his friend and ally. In a great many works the suppliers' representatives are allowed to make their way straight to the storekeeper, with or without the buyer's sanction. This is a great mistake and should not be allowed. If it is necessary to consult the storekeeper, the same plan should be adopted as in the instance of technical orders.

Whether or not the stores should have its own labourers for the loading, unloading, lifting and carrying, of goods, is a point of detail that can only be settled by firms themselves, according to their internal arrangements. Where the stores has to rely on other departments for its labour, it is obvious that the reception its requests meet will largely depend on the personality of either buyer or storekeeper, or both. Hence the importance of tact on both their parts when dealing with other departments.

Accounting.

Accounting is among the most important parts of the buying department's work. Even though orders may have been placed economically, so that price, quality, conditions and time of delivery, terms of payment, and so forth, are all satisfactory, the resultant advantages may be partly, or in certain instances wholly, lost through errors in handling invoices. It is most essential, then, that all invoices for goods should be thoroughly checked over by the clerk responsible, and, where the amounts concerned are large, by the buyer in person. If blunders are made in this respect, the goods may be paid for at rates far in excess of those at which the order was placed, or quantities in excess of those ordered may be accepted without demur. Similarly, any failure to handle invoices promptly may result in inability to claim cash discounts, disorder in the accounting department, and the loss of more remote and conditional benefits dependent on the speedy passing and settlement of invoices.

Should Invoices be Standardised?

A great deal of trouble experienced in handling invoices is due to their diversity of form. One firm will have the order number at the top, another will set it at the bottom; one will put the price on the right-hand side, and the extension on the left; another will keep both together. And in almost every respect variations in the design of invoice forms can be found. This not only increases the length of time devoted to the checking of invoices, since the checker has to look carefully all over the form in order to extract the details he requires, but it also increases the possibility of error, since facts and figures may be overlooked owing to their not being in the accustomed place. For example, most firms insert conditions in regard to cash discounts at the head of their invoice forms. In one instance a firm inserted this information at the foot, in small type. It was overlooked by the checker, who concluded that no cash discount was obtainable. The invoice was for some hundreds of pounds, and over £20 could have been deducted from the amount eventually paid had the line at the bottom been noticed and the account paid promptly.

For this reason many firms insist on invoices being made out on their own forms, which they send, in triplicate, or whatever may be the number required, together with the order. From the buying department's point of view, there is everything to be said for this procedure, though the supplier has obvious objections to it that make him definitely reluctant to comply with the buyer's needs. For instance, the necessity to invoice goods on suppliers' forms would involve his making special duplicate copies for his own books and ledgers. Again, the advertising value of his invoice form, which usually bears his name and a description of his business (and in the case of some enterprising firms carries valuable propaganda in addition), would be lost if he were not allowed to use these forms when invoicing to buyers of his goods.

Double Payment.

The unforgivable sin in the control of invoices is double payment. This is not by any means the infrequent occurrence one might expect. Instances in which it has actually happened will be known to almost all experienced buyers. One in particular occurs at the moment to the writer. The invoice concerned a delivery of a certain material which was commonly ordered by two departments independently. It was passed *by the accountant* in error to deparment A for approval. Department A had had a similar quantity the month before, forgot that it had already passed the invoice for that quantity, and carelessly initialled and approved this second invoice, which went forward for payment in the usual manner. Meanwhile, department B, finding that it had received no invoice for the goods it had ordered and used, mentioned the fact *to the buyer*. The buyer wrote to the supplier, stating that no invoice had been received. A copy was at once forwarded by the supplier, but accidentally the word "copy" was omitted, so that the buyer took it to be the original invoice, overlooked and now despatched. This he sent over to department B, who, as they were justified in doing, passed it for payment. It went forward to the accountant's department, and as it was similar in every respect to other invoices for the same class of goods, frequently received, no question was raised, and the invoice was paid a second time. Only the honesty of the supplier, who discovered the error, led to its rectification. Obviously the cause of this blunder was imperfect co-ordination between the departments. Sometimes invoices went to the accountant, sometimes to the buyer, and both parties were in the habit of dealing with them direct without common consultation. In consequence this double paying of invoices became chronic; eventually a proper system was inaugurated, and all invoices on receipt went to the buying department for approval before going to the departments for signature. When the accountant received an invoice without the buyer's signature, he at once sent it to the purchasing department for prior attention. In this way duplication of payments was avoided.

Need for Invoice Checking.

It must be remembered, in considering this matter of double payment of invoices, that the danger is not merely that two invoices of the same date and amount for the same goods may pass through undetected. There are all sorts of practices that have to be prevented by systematic practice. For example, an urgent order for a hundred brushes may be placed, and, in view of the urgency, the supplier may be asked to despatch a dozen at once by express messenger or post. This he does, and encloses his invoice for the dozen. When the bulk follows, some days later, he may inadvertently send an invoice through the post for the whole hundred, forgetting that an invoice for one dozen has already been sent. If the buyer allows both invoices to go through, payment will be made for 112 instead of 100. Instances of this sort could be multiplied.

Iron and Steelworks and Auxiliary Plant of the Consett Iron Company, Limited.

(*Continued from page* 213.)

before any drying effect takes place upon the outer skin. The time occupied in drying varies, of course, with the size of the material going through. Two of the dryers are served by three tracks and two by four tracks, and as the material is classified on the particular tracks according to its weight, the dryers can be worked to schedule.

From the drying chamber the rack-cars are travelled to any of the kilns being charged. There are eight special kilns, each of a capacity of 100,000 9-in. bricks. Four of these kilns are built entirely of Consett bricks. A visitor will be impressed with the exceptionally robust construction of the kilns, not only in regard to the brickwork, but also the steel bracing; however, the Company have learnt from experience that something more than an ordinary kiln construction is required to stand up against the exceptional temperatures at which the kilns have to operate. The waste heat from the old beehive ovens was utilised to dry the bricks in the fireclay works, and it was thought at first the waste heat from the kilns might be employed for a similar purpose; this, however, did not prove wholly satisfactory in operation, and has been abandoned. The waste heat from the kilns is now utilised to raise steam for the silica brickworks, for which purpose a Babcock waste-heat boiler is installed, and this is served by a Sirocco fan, which, for ease of regulation, is steam-driven. Steam is raised at 160 lbs. and superheated 100 deg. Fah. A stack sufficiently high to pull through the spent gases from the kilns, should it be necessary to by-pass waste heat for boiler-cleaning operations, is provided.

Under normal working conditions it takes approximately five weeks to turn a kiln. The full capacity of the plant is 600 tons of material or, on straight bricks, 200,000 per week. There is perfect technical control of all operations. There is a large central laboratory designed to serve the cokeworks and brickworks. All material is tested before passing to the works, the ground material being graded and screened, whilst for the finished product there are electric furnaces for testing refractories. There is also an experimental kiln.

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Trade Talk.

A new blast furnace of modern type is shortly to be erected at the Shotts Iron Works. It is understood that the contract has been given to an English firm.

Messrs. Allen-Liversidge, Limited, opened last week, at 123, Victoria Street, London, S.W.1, new exhibition rooms for the display of acetylene welding, lighting and other appliances.

Messrs. Henry Robb, Limited, Leith, have obtained an order to build a twin-screw tug fitted with powerful salvage and fire pumps, and intended for service abroad. The machinery to be fitted by the builders will be of 1,500 i.h.p.

The employees of the Combustion Engineering Works, Limited, at Derby, are endowing a bed at the Royal Infirmary, at a cost of £1,000. Mr. J. R. Greenwood, the former general manager of the company, will unveil the bed next Saturday.

The North British Locomotive Company, Limited, Springburn, Glasgow, have secured an order for six Class 10 locomotives for the Rhodesia Railway Company. The firm has also received an order for six tank locomotives for the San Paulo (Brazilian) Railway.

A message from Cape Town states that the South African Railways, within the next twelve months, will spend nearly £2,000,000 on new rolling stock. This sum includes £674,000 for 122 steam locomotives, £694,500 for wagons, and nearly £500,000 for passenger coaches.

The directors of the Bethlehem Steel Corporation have authorised the offer of 800,000 additional shares at $110 in the ratio of one new share for each three held on September 20, the proceeds to be used to redeem $50,166,000 of 30 years sinking-fund 6 per cent. mortgage bonds, Series "A."

An increase of 1s. 8d. per ton in the price of West Coast hematite pig-iron and 2 per cent. in blast-furnace men's wages is revealed by the latest ascertainment under the sliding-scale agreement in force in the North-West of England. The men's wages now stand at 24½ per cent. above the standard.

Second only to the courage and skill of the airman that made the Schneider Trophy victory possible was the highly-specialised craftsmanship which produced the wonderful Rolls Royce engines of the Supermarine S6. The mahogany used in the making of the patterns for these engines was supplied from the seasoned stocks of Messrs. John H. Ashton, Limited, Windsor Bridge, Salford, Manchester, who always carry large stocks of specially-seasoned mahogany, teak, Australian oak and Borneo timbers.

Good progress has been made in recent times in the manufacture of special steels in Sheffield and district for the construction of aircraft of various types. A good deal of the material for the R101, now nearing completion, has been made in the Sheffield area. All the main ribs and longitudinal members of the frame have been made by Messrs. J. J. Habershon & Sons, Limited, of Rotherham, and the weight of steel strip supplied for the airship was over 20 tons. The steel had to give a proof stress of 65 to 75 tons.

Messrs. Thomas W. Ward, Limited, Sheffield, have purchased from Sir Walter Runciman, Bart., the famous yacht "Sunbeam." She belonged originally to the late Earl Brassey, and 50 years ago made a 12 months' tour round the world with Lord and Lady Brassey on board. The vessel is the most famous of privately-owned British yachts and holds the world's record for mileage, having travelled over half a million miles in the course of her existence. The vessel was designed by Mr. St. Clare Byrne and is 157 ft. long and 27 ft. 6 in. extreme beam, with a displacement of 331 tons.

The number of unemployed engineers in Scottish districts increased by 762 during August. In Glasgow the state of trade is far from satisfactory, and the prospect anything but favourable. Trade is good in Paisley, Greenock and Dumbarton, but there has been no improvement in the position indicated a month ago in Kilmarnock and Dumfries districts. Trade in the Dundee area is fair and the immediate prospects good. On the other hand, reports from Edinburgh indicate that the increase in unemployment, which began at the holidays, continues, and that the Leith area is particularly badly affected.

One of the results of the conferences of the British Mission to Argentina has been the negotiation of a provisional agreement which should be of great value to the trade and commercial relations between the two countries. The details of this provisional agreement are under consideration and discussion, but its object is to make provision for the purchase during the next two years of British manufactures to the extent of approximately £8,000,000, required by the Argentine Government for their railways and public works, in return for the purchase through trade channels of Argentine food products to a similar value. The Mission to Argentina included a representative of the British iron and steel industry.

Demolition of premises in Southampton Street and Littles Lane, Wolverhampton, formerly the Culwell Works of Messrs. Joseph Evans & Sons (Wolverhampton), Limited, engineers and iron-founders, has commenced. Messrs. Joseph Evans & Sons' first foundry, with which the manufacture of pumps was associated, was established as far back as 1810, but the premises now in course of demolition were occupied by them only from 1880 until 1893, when they removed to their present large works at Heath Town. When the site is cleared it will afford an opportunity for an extension by Messrs. Meynell & Sons, Limited, of their brass foundry and the erection also of a foundry by another company.

A shipbuilding boom is in progress in Aberdeen; orders for at least 20 vessels have recently been placed by local builders, including steam trawlers, drifters, dredging boats and a twin-screw steamer. Messrs. John Lewis & Sons, Limited, have just received the following orders:—Two experimental boats fitted up as trawlers, drifters and seine netters (combined) for the Russian Soviet Government at Vladivostock; two trawlers, through Mr. Thomas Irvine, for the Crater Steam Fishing Company, North Shields; two trawlers for Mr. H. A. Holmes, Aberdeen; and one twin-screw steamer for Messrs. Howard & Smith, Australia. The execution of these orders will provide a considerable amount of work for Torry shipyard workers, and may well mark a new era of prosperity for an industry which has experienced hard times for a number of years. The firm of Messrs. John Lewis & Sons, Limited, of which Sir Andrew Lewis, the Lord Provost of Aberdeen, is the head, is one of the leading shipbuilding concerns in the north of Scotland.

Personal.

Mr. P. G. Penny has been appointed general manager of Combustion Engineering, Limited, Sinfin Lane, Derby. He formerly held an appointment with International Combustion, Limited, London.

Major Richard Miles has been appointed to manage the ironworks department of Messrs. Newton, Chambers & Company, Limited, Thorncliffe Ironworks and Collieries, near Sheffield, in succession to his father, the late Mr. T. V. Miles, director and general manager.

The newly-formed private company of Calderwood, Young & Company, Limited, is unusually interesting in that it represents the association of Mr. Y. A. Calderwood—an engineer of wide experience in Great Britain, France, Belgium and Russia—with Mr. H. J. Young, an engineering chemist, metallurgist and oil expert well known throughout marine and shipping circles and in the foundry industry. The company will function as merchants, agents, representatives, importers and exporters, and its clients will have the benefit of the sound practical experience—in two allied sciences—of the two directors. The registered offices of the company are at 3, Central Buildings, Westminster, London, S.W.1.

Wills.

Crichton, George MacRitchie, iron and steel merchant, Dundee £11,611

Appleby, John Richard, engineer and managing director, Messrs. J. Broadfoot & Company, Limited, Scotstoun, Glasgow £10,530

Reports and Dividends.

Brown Brothers, Limited.—Interim dividend on the ordinary shares at the rate of 2½ per cent.

William Bayliss, Limited.—Net profit, £4,544; brought in, £2,614; dividend of 7½ per cent., less tax, £3,600; carried forward, £3,559.

Sheffield Forge and Rolling Mills Company, Limited.—Profit for year of £2,177, reducing the debit balance to be carried forward to £60,703.

Wright, Bindley & Gell, Limited.—Balance of revenue account, including £3,242 brought in, £12,673; dividend of 5 per cent. on the ordinary shares; carried forward, £2,258.

Obituary.

We regret to announce the death of Mr. H. Van Aarst, which took place at Amsterdam on September 3, in his 64th year. Mr. Van Aarst was one of the best-known foundrymen in Western Europe; he was President of the Dutch Foundry Owners' Association, the Dutch Foundry Technical Association, and was one of the representatives of Holland on the International Committee of Foundry Technical Associations. He was also well known to many British foundrymen. In 1924 he presented a Paper on "The Foundry Cupola" to the Newcastle Convention of the Institute of British Foundrymen, and at the recent International Foundrymen's Convention, held in London, he was the author of a Paper on "The Problem of Moulding Sand." The funeral took place at Amsterdam on September 6.

Iron and Steel Output in August.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast at the end of August was 170, an increase of three since the beginning of the month. The production of pig-iron in August amounted to 682,000 tons, compared with 671,900 tons last July and 519,000 tons in August, 1928; last month's production included 206,900 tons of hematite, 280,100 tons of basic, 140,200 tons of foundry and 26,700 tons of forge pig-iron. The August output of steel ingots and castings amounted to 753,300 tons, compared with 804,800 tons last July and 648,300 tons in August, 1928.

In the first seven months of this year India exported to the United States no less than 30,559 tons of pig-iron, compared with 26,774 tons in the corresponding period of 1928.

Students' Corner.

Q.—What are the percentages of the various constituents of pig-iron in relation to grade numbers?

A.—The analysis of pig-iron will differ according to the various mixtures of ores, or ironstone, but taking a Cleveland or a Derbyshire brand the constituents would approximate to the following:—

No. 1 Grade:—Combined carbon (C.C.), 0.15; graphitic carbon (Gr.), 3.30; silicon (Si), 3.00; manganese (Mn), 1.0; sulphur (S), 0.02; and phosphorus (P), 1.50 per cent.

No. 2 Grade:—C.C., 0.20; Gr., 3.15; Si, 2.75; Mn, 0.75; S, 0.03; and P, 1.50 per cent.

No. 3 Grade:—C.C., 0.25; Gr., 3.00; Si, 2.50; Mn, 0.65; S, 0.04; P, 1.50 per cent.

No. 4 Grade:—C.C., 0.35; Gr., 2.28; Si, 2.00; Mn, 0.60; S, 0.05; and P, 1.50 per cent.

No. 5 Grade:—C.C., 0.65; Gr., 2.50; Si, 1.70; Mn, 0.55; S, 0.06; and P, 1.50 per cent.

No. 6 Grade (Mottled):—C.C., 1.50; Gr., 1.50; Si, 1.00; Mn, 0.50; S, 0.09; and P, 1.50 per cent.

No. 7 White Iron:—C.C., 3.00; Gr., nil; Si, 0.70; Mn, 0.30; S, 1.10; and P, 1.50 per cent.

Silicon, phosphorus, sulphur and carbon are non-metals. The first one may be considered a metaloid; manganese is a metal. Carbon is the only element of the constituent that exists in the free state. When it is combined it is chemically iron carbide.

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WHOSE USE WEAKENS THE NATIONAL RESOURCES

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The position in the Cleveland iron trade has so far developed few signs of the increased activity usually experienced at this period of the year, buying on autumn account still remaining on restricted lines, as is invariably the case when values rule at excessively high levels. Consequently buyers are disinclined to operate freely, and business continues dull. It is, however, anticipated that heavy industrial requirements have yet to be covered, and the ironmasters have not a great deal to sell, having already a fair number of contracts in hand for the last quarter of the year. Export demands are still on a moderate scale, a position which, however regrettable from the standpoint of national economics, the ironmasters themselves can contemplate without undue concern, provided that home requirements do not fall short of anticipations. Prices, therefore, remain firm, and no concessions are made on the following minimum scale of quotations:—No. 1 Cleveland foundry iron, 75s. per ton; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; No. 4 forge, 71s. per ton.

The market for East-Coast hematite continues fairly active, but producers are not without anxiety as to the future outlook, recent efforts to stimulate prices to higher levels having been unsuccessful, while works costs are on the increase. It is admittedly impossible in present conditions of the industry to realise higher values either at home or abroad, and, unless something comes along to give the market a fillip, there is a half-concealed fear that a few hematite furnaces may have to go out of blast. Meanwhile, hematite mixed numbers are quoted at 76s. per ton, and No. 1 quality at 76s. 6d. On the North-West Coast mixed numbers remain firm at 75s. per ton at works.

LANCASHIRE.—A significant sign of increasing activity in local markets for foundry pig-iron is an insistent demand for fuller deliveries during the current month, while stocks of No. 3 are rapidly diminishing at furnaces. Prices, however, continue stationary, with No. 3 Staffordshire quoted at 75s. 6d., No. 3 Derbyshire at 74s. 6d., and Scottish brands at 92s. 6d. to 93s. 6d., all per ton delivered local stations.

THE MIDLANDS.—The Birmingham market for foundry pig has also developed an increased demand of late, many consumers now covering their requirements up to the end of the year. Pig-iron has been taken from the furnaces in good tonnages, and the general opinion is that there are signs of a considerable expansion of trade in the district. Quotations rule firm, as follow:—No. 3 Staffordshire, 77s.; No. 3 Derbyshire, 76s.; and No. 3 Northants, 72s. 6d., all per ton, delivered local stations.

SCOTLAND.—Business in the markets for Scotch pig-iron continue exceedingly quiet, and founders generally complain of the lack of work. The price of Scottish pig-iron is maintained on the basis of 76s. for No. 3 foundry f.o.t. furnaces, with an addition of 2s. 6d. per ton for No. 1 quality.

Finished Iron.

In the Black Country makers of marked bars are very well engaged for the time being, and are hopeful that still further improvement will be felt during the next few months. There is no alteration in the price, which is still £12 per ton at works. The price of crown bars varies according to the district. A good Staffordshire crown iron would cost £10 to £10 5s., but from other districts crown bars are offered at anything from £9 15s. to £10. The Lancashire bar-iron makers seem to have little hope of business expanding much above its present level, and further weakness in foreign No. 3 bars has added to their difficulties in selling material to nut and bolt makers. Prices are maintained, however, at £10 15s. per ton for crown-quality material, and £9 15s. for seconds.

Steel.

Markets for finished steel and semi-products continue moderately active, with basic billets still a strong feature. There is rather more Continental competition, but it does not greatly interfere with the demand for British billets. No improvement is to be noted in the call for Siemens acid billets. There is good business in wire rods. Current Sheffield prices: Basic billets, soft, £7; semi-hard, £7 12s. 6d.; medium, £8 2s. 6d.; hard, £9 2s. 6d. to £9 12s. 6d.; Siemens acid, £9 10s.; wire rods, soft basic, £8 10s.; medium hard, £9 10s. to £10; hard, £10 15s.; acid, £12 5s. to £12 10s. The tone of the tinplate market is quite satisfactory as concerns inquiries, and prices remain firm, coke quality being quoted at 18s. 6d. to 18s. 9d. basis, net cash, f.o.b. Welsh ports.

Scrap.

Conditions in the markets for foundry scrap material vary to a certain extent, but prices generally remain firm. On Tees-side foundrymen are still paying 67s. per ton for ordinary heavy cast iron, but no more than 68s. 6d. is obtainable for good machinery quality. At Sheffield, heavy cast-iron scrap is rather less in request, ordinary quality being at about 65s. and machinery quality at 66s. 6d. In Scotland, machinery cast-iron scrap, suitable for foundries, is quoted at 70s., and for ordinary cast iron to the same specification 65s. per ton is asked. Old railway chairs are at 67s. 6d. to 68s. 6d. per ton, with light metal at 60s., all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Increasing firmness in values has again been marked in recent movements in warrant copper, last week's close recording a further advance both in cash and three months' transactions. Buyers in Europe who were not too well covered have also entered the market, and it is reported that sales both in this country and in America have been on a larger scale than at any time since the boom which took place in the early part of the year.

Closing quotations are :—

Cash.—Thursday, £76 13s. 9d. to £76 16s. 3d.; Friday, £75 15s. to £75 17s. 6d.; Monday, £75 2s. 6d. to £75 3s. 9d.; Tuesday, £74 2s. 6d. to £74 5s.; Wednesday, £74 12s. 6d. to £74 15s.

Three Months.—Thursday, £77 3s. 9d. to £77 6s. 3d.; Friday, £76 2s. 6d. to £76 3s. 9d.; Monday, £75 10s. to £75 11s. 3d.; Tuesday, £74 12s. 6d. to £74 15s.; Wednesday, £75 2s. 6d. to £75 3s. 9d.

Tin.—The position in the market for standard tin has developed an irregular tendency of late, with values distinctly weaker than have recently been recorded. The statistics have served forcibly to demonstrate that, in spite of the high rate of consumption, the position as regards excess supplies has not yet been corrected. With regard to the future, the position is uncertain, but it is evident that Group support will be required from time to time to maintain prices at any fixed level, although seasonal demands may in their turn cause rallies.

Official closing prices :—

Cash.—Thursday, £204 10s. to £204 12s. 6d.; Friday, £205 to £205 5s.; Monday, £205 12s. 6d. to £205 15s.; Tuesday, £205 7s. 6d. to £205 10s.; Wednesday, £204 7s. 6d. to £204 10s.

Three Months. — Thursday, £208 10s. to £208 12s. 6d.; Friday, £208 17s. 6d. to £209; Monday, £209 12s. 6d. to £209 15s.; Tuesday, £209 5s. to £209 7s. 6d.; Wednesday, £208 2s. 6d. to £208 5s.

Spelter.—Consumptive demand for ordinary spelter continues slow, and, generally speaking, the market is weak. This is accounted for to a certain extent by large arrivals, which were in excess of requirements, and which occasioned some heavy liquidations among speculative holders. No improvement can be anticipated until there is a general revival of interest among buyers.

Daily quotations are :—

Ordinary.—Thursday, £24 3s. 9d.; Friday, £24 6s. 3d.; Monday, £24 6s. 3d.; Tuesday, £24 6s. 3d.; Wednesday, £24 8s. 9d.

Lead.—Although conditions are quiet, markets have remained steady, and sellers show no anxiety to press sales. With regard to the future, the undertone is firm, and it is regarded as possible that values may shortly develop a hardening tendency.

Prices have been :—

Soft Foreign (Prompt).—Thursday, £23 10s.; Friday, £23 8s. 9d.; Monday, £23 8s. 9d.; Tuesday, £23 11s. 3d.; Wednesday, £23 10s.

Institute of Metals.

(*Continued from page* 204.)

train to the new blast-furnace plant, and thence through the Siemens-Martin tilting furnace shop, rolling mills for rod, sheet and tyres, hydraulic forging presses (including the only 10,000 forging press in the world), steel foundries and finishing shops. According to an old tradition, women are not allowed inside the Krupp works, so arrangements had been made for the ladies of the party to visit a flower and garden exhibition and certain welfare centres at Essen, although no doubt some of them would have preferred to have come round the works. The two parties, however, joined up at lunch, which was kindly provided by the directors at their own hotel in Essen. After lunch members visited the research laboratories, although time only permitted of a very hurried visit.

Social Events.

No account of the Autumn Meeting would be complete without some reference to the social side. In this connection, the local Reception Committee are again to be congratulated. On Tuesday evening members and their ladies were entertained to a dinner and dance by the Lord Mayor of Düsseldorf (Dr. Lehr). In accordance with German custom on these occasions, this continued until the early hours of the morning. Similarly, the Cabaret evening in the rooms and garden of the Malkasten (Artists' Club), Düsseldorf, was an all-night affair, and most of the members, bearing in mind the early start for Essen, did not see it through. In addition, during the mornings when members were engaged on more serious matters, the ladies were taken on sight-seeing tours around Düsseldorf.

De-rating and Idle Ironworks.

At the Ayrshire court the Inland Revenue Authorities appealed against the Assessor's proposal to include Eglinton Iron Works and Ardeer Iron Works as industrial lands and heritages entitled to benefit under the provisions of the De-rating Act. It was contended that, as the premises had been closed for a considerable time, the conditions had not been fulfilled. Mr. W. D. Patrick, who appeared for Messrs. William Baird & Company, Limited, proprietors of Eglinton Iron Works, said since the works had been idle repairs had been carried out where necessary to keep the furnaces in condition to start again. Skilled workmen had also been retained at other work so as to have them available when resumption became possible. The Act was passed to encourage industry, yet, if relief was not granted in a case of this kind it would place the works that had been idle in a worse position than works that were going. A similar argument was submitted with regard to Ardeer Iron Works. The appeal was dismissed, and the Inland Revenue asked that a case be stated for appeal. At the Coatbridge Court the Assessor's proposals were appealed against by the Revenue authorities in regard to a number of idle ironworks. The Court dismissed the appeals in all cases.

Owner Wanted.

We have in our care a Burberry mackintosh which was stated by the management to have been left in the Monopol Hotel, Düsseldorf, by a member of the British Cast Iron Research Association.

"Konel," a New Metal.—Development of a new metal known as "Konel," which is credited with being much stronger than other metals at high temperatures, and can be used extensively in the moving parts of internal-combustion engines and in other extremely hot places, has been announced by officials of the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pennsylvania, U.S.A. The new metal is harder to forge than steel, and very tough at high temperatures, when most metals lose strength. It costs only a few dollars a pound.

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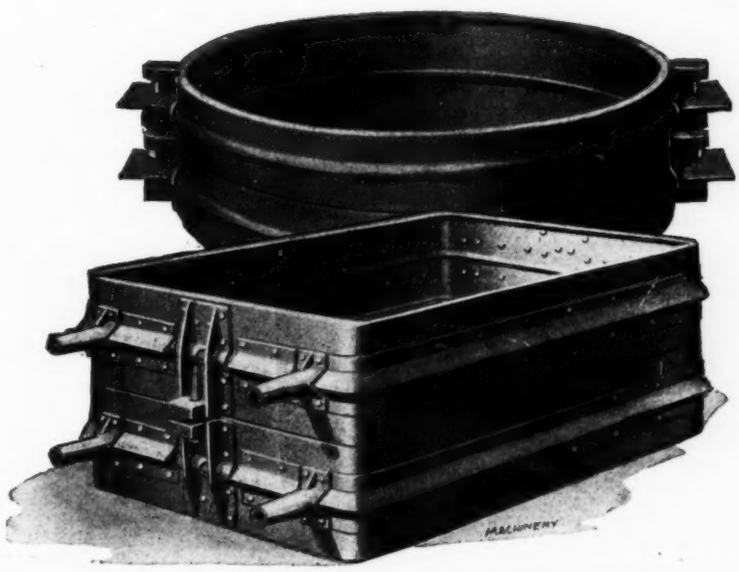

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COPPER.

	£	s.	d.
Standard cash	74	12	6
Three months	75	2	6
Electrolytic	84	5	0
Tough	78	10	0
Best selected	79	0	0
Sheets	110	0	0
India	96	10	0
Wire bars	84	12	6
Do. Oct.	84	12	6
Do. Nov.	84	12	6
Ingot bars	—		
H.C. wire rods	86	15	0
Off. av. cash, August	73	16	8½
Do. 3 mths., August	74	12	2½
Do., Sttlmnt., August	73	16	3½
Do., Electro, August	84	10	0
Do., B.S., August	78	5	10
Aver. spot price, copper, Aug.	73	16	8½
Do. wire bars, August	84	15	0

Solid drawn tubes .. 15d.
Brazed tubes .. 15d.
Wire .. 11½d.

BRASS.

Solid drawn tubes .. 12½d.
Brazed tubes .. 14½d.
Rods, drawn .. 12½d.
Rods, extd. or rlld. .. 8d.
Sheets to 10 w.g. .. 11½d.
Wire .. 11½d.
Rolled metal .. 10½d.
Yellow metal rods .. 8d.
Do. 4 × 4 Squares .. 8½d.
Do. 4 × 3 Sheets .. 9d.

TIN.

	£	s.	d.
Standard cash	204	7	6
Three months	208	2	6
English	204	10	0
Bars	207	10	0
Straits	209	7	6
Australian	207	17	0
Eastern	214	10	0
Banca	217	7	6
Off. av. cash, August	209	17	11½
Do., 3 mths., August	213	17	6
Do., Sttlmt., August	209	17	7½
Aver. spot, August	209	17	11½

SPELTER.

	£	s.	d.
Ordinary	24	8	9
Remelted	22	10	0
Hard	20	15	0
Electro 99.9	26	5	0
English	24	15	0
India	21	10	0
Zinc dust (Nom.)	34	10	0
Zinc ashes	8	15	0
Off. aver., August	25	0	7½
Aver., spot, August	24	17	11

LEAD.

	£	s.	d.
Soft foreign ppt.	23	10	0
English	25	0	0
Off. average, August	23	4	5 7/8
Average spot, August	23	3	8½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	33	5	0
Do. V.M. ex-whf.	32	2	6
Rods	40	0	0
Boiler plates	30	0	0
Battery plates	30	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	50	5	0
Chinese	31	15	0
Crude	Nominal		

QUICKSILVER.

	£	s.	d.
Quicksilver	22	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	15	0
45/50%	12	0	0
75%	19	10	0
Ferro-vanadium—			
35/50%	12/10 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/- lb. Mo.		
Ferro-titanium—			
23/25% carbonless	11d. lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%, c. fr.	3/3½ lb.		
Tungsten metal powder—			
98/99%	3/6½ lb.		
Ferro-chrome—			
2/4% car.	£32	10	0
4/6% car.	£23	7	6
6/8% car.	£22	10	0
8/10% car.	£22	0	0
Ferro-chrome—			
Max. 2% car.	£33	0	0
Max. 1% car.	£37	12	6
Max. 0.70% car.	£40	0	0
70%, carbonless	1/2 lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/4 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/6 lb.		
Ferro-manganese (net)—			
76/80% loose	£13	15	0
76/80% packed	£14	15	0
76/80%, export	£14	0	0
Metallic manganese—			
94/96%, carbonless	1/6 lb.		

Per ton unless otherwise stated.

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Finished bars, 14% tungsten £0 2 0
Finished bars, 18% tungsten £0 2 9
Per lb. net, d/d buyers' works.

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Rounds and squares, 3 in. and over .. 4d. lb.
Rounds and squares, under ½ in. to ¼ in. .. 3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in. .. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in. .. 3d. lb.
Do., under ½ in. × ¼ in. .. 1/- lb.
Bevels of approved sizes and sections .. 6d. lb.
Bars cut to length, 10% extra

SCRAP.

South Wales—	£	s.	d.		£	s.	d.
Heavy steel	3	14	0	to	3	15	0
Bundled steel and shrngs.	3	10	0	to	3	15	0
Mixed iron and steel	3	10	0				
Heavy cast iron	2	17	6	to	3	0	0
Good machinery for foundries	3	0	0	to	3	2	6
Cleveland—							
Heavy steel	3	6	6				
Steel turnings	2	16	6				
Cast iron borings	2	15	0				
Heavy forge	3	17	6				
W.I. piling scrap	3	11	6				
Cast-iron scrap	3	7	0	to	3	8	6
Lancashire—							
Cast-iron scrap	3	2	6	to	3	10	0
Hvy. wrought	3	17	6				
Steel turnings	3	0	0				
Scotland—							
Heavy steel	3	17	6				
Cast-iron borings	2	14	6				
Wrought-iron piling	3	18	6				
Heavy machinery	3	10	0				

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	68	0	0
Brass	44	0	0
Lead (less usual draft)	21	5	0
Tea lead	17	0	0
Zinc	16	10	0
New aluminium cuttings	68	0	0
Braziery copper	60	0	0
Gunmetal	61	0	0
Hollow pewter	150	0	0
Shaped black pewter	106	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—
Foundry No. 1 .. 75/-
Foundry No. 3 .. 72/6
Foundry No. 4 .. 71/6
Forge No. 4 .. 71/-
Hematite No. 1 .. 76/6
Hematite M/Nos. .. 76/-

N.W. Coast—
Hem. M/Nos. d/d Glas. .. 86/-
„ d/d Birm. .. 92/-

Midlands—
Staffs. common* .. —
„ No. 4 forge* .. 73/-
„ No. 3 fdry* .. 77/-
Shrops. basic .. —
„ Cold blast, ord. .. —
„ „ roll iron .. —
Northants forge* .. 68/6
„ fdry. No. 3* .. 72/6
Derbyshire forge* .. 72/-
„ fdry. No. 3* .. 76/-
„ basic* .. —

* d/d Black Country dist.

Scotland—
Foundry No. 1 .. 78/6
„ No. 3 .. 76/-
Hem. M/Nos. .. 80/-

Sheffield (d/d district)—
Derby forge .. 67/-
„ fdry. No. 3 .. 71/-
Lincs. forge .. —
„ fdry. No. 3 .. 74/6
E.C. hematite .. 87/-
W.C. hematite .. 87/6

Lincs. (at furnaces)—
Forge No. 4 .. —
Foundry No. 3 .. —
Basic .. —

Lancashire (d/d eq. Man.)—
Derby forge .. —
„ fdry. No. 3 .. 74/6
Northants foundry No. 3 .. —
Dalzell, No 3 (special) 102/6 to 105/-
Summerlee, No. 3 .. 93/-
Glengarnock, No. 3 .. —
Gartsherrie, No. 3 .. 93/-
Monkland, No. 3 .. 93/-
Shotts, No. 3 .. 93/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.) nom.					10	15	0
Nut and bolt iron	9	0	0	to	9	5	0
Hoops	11	0	0	to	11	10	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	11	0	0	to	11	10	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	12	6	to	8	17	6
Boiler plts.	9	12	6	to	10	10	0
Chequer plts.					10	12	6
Angles					8	2	6
Tees					9	2	6
Joists					8	2	6
Rounds and squares, 3 in. to 5½ in.					9	2	6
Rounds under 3 in. to ⅜ in. (Untested)					8	0	0
					and upwards		
Flats, over 5 in. wide and up					8	7	6
Flats, 5 in. to 1½ in.					7	17	6
Rails, heavy					8	10	0
Fishplates					12	10	0
Hoops (Staffs)					10	0	0
Black sheets, 24g.	10	5	0	to	10	10	0
Galv.cor.shts., 24g.	13	5	0	to	13	10	0
Galv. fencing wire 8g. plain					12	0	0
Billets, soft	6	7	6	to	6	15	0
Billets, hard	7	10	0	to	8	0	0
Sheet bars					6	5	0
Tin bars					6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6½
Rods	1/5
Tubes	1/9½
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bessemer billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.95
Tank plates	1.95
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.85
Sheets, galv., No. 24	3.50
Sheets, blue an'l'd, No. 13	2.35
Wire nails	2.55
Plain wire	2.40
Barbed wire, galv.	3.20
Tinplates, 100 lb. box	$5.35

COKE (at ovens).

Welsh foundry .. 25/- to 30/-
„ furnace .. 22/- to 24/-
Durham and North.
„ foundry .. 22/6
„ furnace .. 20/6 to 21/6
Midlands, foundry .. —
„ furnace .. 21/6 and up

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box	18/6
„	28×20 „	37/-
„	20×10 „	26/9
„	18¾×14 „	19/6
C.W.	20×14 „	15/3
„	28×20 „	33/6
„	20×10 „	22/6
„	18¾×14 „	16/-
Terneplates	28×20	33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods, dead soft, steel	£10	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ¼ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	65% ..	.. 47½%
Water	61½% ..	.. 42½%
Steam	57½% ..	.. 37½%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Sept.	12 ..	76	13	9	inc.	10/-
,,	13 ..	75	15	0	dec.	18/9
,,	16 ..	75	2	6	,,	12/6
,,	17 ..	74	2	6	,,	20/-
,,	18 ..	74	12	6	inc.	10/-

Electrolytic Copper.

		£	s.	d.		
Sept.	12 ..	84	10	0	No	change
,,	13 ..	84	10	0	,,	,,
,,	16 ..	84	10	0	,,	,,
,,	17 ..	84	5	0	dec.	5/-
,,	18 ..	84	5	0	No	change

Standard Tin (cash).

		£	s.	d.		
Sept.	12 ..	204	10	0	inc.	5/-
,,	13 ..	205	0	0	,,	10/-
,,	16 ..	205	12	6	,,	12/6
,,	17 ..	205	7	6	dec.	5/-
,,	18 ..	204	7	6	,,	20/-

Tin (English ingots).

		£	s.	d.		
Sept.	12 ..	204	10	0	No	change
,,	13 ..	205	0	0	inc.	10/-
,,	16 ..	205	15	0	,,	15/-
,,	17 ..	205	10	0	dec.	5/-
,,	18 ..	204	10	0	,,	20/-

Zinc Sheets (English).

		£	s.	d.		
Sept.	12 ..	33	10	0	dec.	20/-
,,	13 ..	33	10	0	No	change
,,	16 ..	33	10	0	,,	,,
,,	17 ..	33	5	0	dec.	5/-
,,	18 ..	33	5	0	No	change

Spelter (ordinary).

		£	s.	d.		
Sept.	12 ..	24	3	9	dec.	3/9
,,	13 ..	24	6	3	inc.	2/6
,,	16 ..	24	6	3	No	change
,,	17 ..	24	6	3	,,	,,
,,	18 ..	24	8	9	inc.	2/6

Lead (English).

		£	s.	d.		
Sept.	12 ..	25	0	0	inc.	5/-
,,	13 ..	25	0	0	No	change
,,	16 ..	25	0	0	,,	,,
,,	17 ..	25	0	0	,,	,,
,,	18 ..	25	0	0	,,	,,

Exports of Iron Castings in August and the eight months 1929, compared with August and the eight months 1928.

	August, 1928.	August, 1929.	Eight months, 1928.	Eight months, 1929.	August, 1928.	August, 1929.	Eight months, 1928.	Eight months, 1929.
BUILDERS' CASTINGS—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers—								
To Argentine Republic	175	100	1,223	1,365	6,485	5,114	51,370	63,204
,, British South Africa	302	270	2,439	2,385	10,603	9,944	85,067	85,390
,, ,, India	125	121	1,028	1,132	5,205	5,056	44,854	43,871
,, Australia..	52	49	459	491	3,032	2,476	31,851	27,903
,, New Zealand	125	114	1,286	931	6,606	5,419	64,927	57,999
,, Other countries..	869	797	6,347	6,717	39,907	36,674	293,819	307,208
Total	1,648	1,451	12,782	13,021	71,838	64,683	571,888	585,575
PIPES AND FITTINGS—CAST—								
To Argentine Republic	852	2,298	6,334	18,195	8,121	20,098	64,315	170,948
,, British South Africa	213	382	3,140	4,605	2,952	5,964	49,833	61,154
,, ,, India	573	397	6,030	3,197	10,631	5,079	79,962	43,076
,, Straits Settlements and Malay States	1,241	764	10,635	15,522	13,396	5,747	97,361	113,027
,, Ceylon	830	277	1,597	1,509	6,826	2,589	16,199	15,428
,, Australia..	382	100	6,461	2,851	5,875	1,675	72,160	31,206
,, Other countries..	5,005	6,651	38,984	41,423	65,748	78,338	512,457	506,419
Total	9,096	10,869	73,181	87,302	113,549	119,490	892,287	941,258
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	380	467	3,088	3,178	12,234	15,605	113,847	114,067
,, Enamelled	61	93	521	621	6,525	8,354	49,219	55,618
CASTINGS, in the rough—								
Iron	76	104	1,032	1,028	3,386	4,162	32,825	37,399
Steel	30	191	412	857	1,096	7,566	19,434	35,383

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34-in. Swing DEFRIES Vertical Boring and Turning Mill, with 30-in. chuck.

No. 60 HEALD Internal Grinding Machine, with planetary head.

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5-Ton. ALL-STEEL STEAM TRAVELLING DERRICK CRANE (Wilson), 50-ft. jib; boiler for 80 lbs. w.p.

VERTICAL COCHRAN LAND TYPE BOILER, for gas firing, 16 ft. 3 in. high x 7 ft. 6 in. dia., working pressure 80 lbs. per sq. in.

16,000 ft. 1½-in. New Black Steel Screwed and Socketed PIPING in lengths of 18 ft. and upwards.

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J. W. BISPHAM,
Principal.

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12′ × 9′ Room Plant, complete with compressor and all equipment **£340**

Large Barrel Plant, suitable for castings up to 20 lb. weight, complete with compressor and all equipment **£180**

Cabinet Plant, complete with vertical compressor and all equipment **£60**

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